[Course Overview](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live)

[Course Overview](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live)

[Hi, everyone. My name is Austin Bingham,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=5.33) [and welcome to the course, Core Python:](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=7.24) [Getting Started. My coauthor, Robert](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=9.06) [Smallshire, and I are founders and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=11.47) [principle consultants at Sixty NORTH.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=12.92) [Python is a big language, and it's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=15.76) [important to have a thorough grounding in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=17.32) [its key concepts in order to be productive](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=18.85) [and create high‑quality Python programs.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=20.87) [In our experience, starting off in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=23.43) [right direction and avoiding early](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=25.12) [misconceptions is crucial to success with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=26.51) [Python, and that's the kind of start we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=28.61) [aim to provide with this course. In this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=30.34) [course, we're going to introduce you to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=33.06) [the essentials of the Python language, as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=34.74) [well as important parts of the Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=36.61) [standard library. Some of the major topics](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=37.94) [that we will cover include Python's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=40.52) [fundamental data types, using functions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=42.26) [and modules to organize your code,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=44.72) [Python's underlying object model, defining](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=46.84) [your own types using classes, and working](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=49.45) [with iteration and iterable objects. By](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=51.82) [the end of this course, you'll know what](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=54.86) [you need to work on many Python projects,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=56.44) [and you'll be in a great position to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=58.63) [continue learning more advanced aspects of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=60.06) [Python. Before beginning the course, you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=61.91) [should be familiar with basic computer](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=64.58) [concepts, like files and running programs.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=66.1) [This course doesn't assume any specific](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=68.73) [programming experience, but a basic](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=70.45) [understanding of concepts like functions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=72.26) [and program execution can be helpful. From](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=73.92) [here, you should feel comfortable diving](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=76.57) [into other Core Python language courses on](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=78.16) [Organizing Larger Programs, Classes and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=80.43) [Object‑Orientation, Functions and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=82.69) [Functional Programming, and Robust](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=84.77) [Resource and Error Handling. I hope you'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=86.7) [join me on this journey to learn about the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=89.19) [Python programming language with the Core](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=90.71) [Python: Getting Started course at Pluralsight.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bebaab0d-57da-4e1d-916c-396ae6117677&clip=0&mode=live&start=92.53)

[Installing and Starting Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live)

[Overview](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live)

[In this module, we'll cover obtaining and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=1.44) [installing Python on your system for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=3.52) [Windows, Ubuntu Linux, and macOS. We'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=5.17) [write some basic Python code and become](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=8.43) [acquainted with the essentials of Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=10.21) [programming culture, such as the Zen of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=11.76) [Python. Though we'll never forget the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=13.67) [origins of the name of the language. There](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=15.83) [are two major versions of the Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=18.59) [language, Python 2, which is the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=20.36) [widely‑deployed legacy language, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=22.32) [Python 3, which is the present and future](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=24.43) [of the language. It's now over a decade](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=26.54) [since the transition from Python 2 to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=28.81) [Python 3 was begun, and we strongly](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=30.4) [recommend that all new projects are begun](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=32.43) [with Python 3 as Python 2 will not be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=34.56) [maintained from the year 2020. That said,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=36.89) [most of the Python code we will](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=40.26) [demonstrate will work without modification](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=41.45) [between the last version of Python 2,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=43.4) [which is Python 2.7, and recent versions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=45.35) [of Python 3, such as Python 3.8. However,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=48.19) [there are some key differences, and in a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=52.41) [strict sense, the languages are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=54.3) [incompatible. We'll be using Python 3 for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=55.69) [this course, and everything we show will](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=58.45) [work on Python 3.6 or later, and most](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=60.32) [things will work on Python 3.3 or later.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=63.01) [We're also confident that everything we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=66.4) [present will apply to future versions of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=68.1) [Python 3, so don't be afraid to try those as they become available.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=0&mode=live&start=69.81)

[Installing Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live)

[Before we can start programming in Python,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=1.24) [we need to get hold of a Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=3.03) [environment. Python is a highly portable](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=4.28) [language available on all major operating](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=6.56) [systems. You will be able to complete this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=8.65) [course on Windows, Mac, or Linux, and the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=10.83) [only major section where we diverge into](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=13.61) [platform specifics is coming right up, as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=15.36) [we install Python 3. As we cover the three](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=17.69) [platforms, feel free to skip over the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=20.64) [sections which aren't relevant for you.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=22.96) [Let's see how to install Python 3 on](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=26.5) [Windows 10. For Windows, you need to visit](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=28.46) [the official Python website at python.org](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=31.82) [and then navigate via the Downloads tab to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=34.59) [the downloads for Windows and click the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=36.87) [button to begin downloading the latest](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=38.71) [Python 3 version. When given the option,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=40.38) [choose to run the installer. After the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=43.59) [installer starts, be sure to enable the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=46.17) [option to add Python to the PATH](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=48.15) [environment variable before moving on by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=49.65) [clicking Install Now. You may be asked to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=51.77) [approve the Python Installer making](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=54.83) [changes to your device, which you should](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=56.27) [accept. After a few seconds, the installer](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=57.99) [will complete and you can close the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=61.22) [installer and your web browser. We'll be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=62.72) [working with Python from the command line,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=66.48) [so via the Start button, choose Windows](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=68.225) [PowerShell. On older versions of Windows,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=70.33) [you may need to use the Command shell](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=72.505) [instead, and start Python just by typing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=74.37) [python, followed by Enter. Welcome to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=76.95) [Python. The triple arrow prompt shows you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=79.95) [that Python is waiting for your input. At](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=82.14) [this point, you might want to skip forward](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=84.72) [while we show you how to install Python on](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=86.6) [Mac and Linux. Now let's see how to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=88.44) [install Python 3 on macOS. For macOS, you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=92.92) [need to visit the official Python website](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=96.75) [at python.org. Navigate via the Downloads](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=98.58) [tab to the downloads for macOS, and click](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=101.94) [the button to begin downloading the latest](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=104.37) [Python 3 version. A PKG file downloads,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=106.16) [which, when opened, launches the Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=109.87) [Installer. Continue through the install](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=111.83) [process, accepting the license agreement](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=115.1) [and using the default installation](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=117.18) [location. You may need to provide your](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=118.69) [password as you go. Although macOS does](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=120.92) [include a Python interpreter, it's the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=124.38) [legacy Python 2.7 version, and for this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=126.31) [course we use Python 3. The Python 3](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=129.03) [version we're installing here will sit](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=131.77) [alongside your system Python 2 and won't](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=133.29) [interfere with the correct operation of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=135.69) [your Mac. When Python is installed, you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=137.26) [can clean up by moving the installer to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=140.35) [the trash. To use Python, open a terminal,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=142.07) [here we're using Spotlight to do so, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=145.32999999999998) [run Python 3 from the command line.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=147.78) [Welcome to Python. The triple arrow prompt](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=150.44) [shows that Python is waiting for your](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=152.7) [input. The last operating system we'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=154.18) [look at is Linux, which is the easiest of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=158.21) [all. Recent versions of Ubuntu Linux](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=160.16) [include Python 3 out of the box, so no](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=162.69) [installation is required. To begin using](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=165.02) [Python, open a terminal. On Ubuntu we can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=167.67) [do this by using the search function](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=170.39499999999998) [accessible through the Ubuntu icon on the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=172.04) [top left, entering terminal, and launching](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=173.92) [the terminal application. In the terminal,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=176.57) [you should be able to start Python 3.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=179.65) [Welcome to Python. The triple arrow prompt](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=182.31) [shows you that Python is waiting for your](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=184.59) [input. If you're using a version of Linux](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=186.07) [other than Ubuntu, you'll need to find out](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=188.87) [how to invoke and, if necessary, install Python 3 on your system.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=1&mode=live&start=190.93)

[Interactive Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live)

[Now that Python is installed and running,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=1.01) [we can immediately start using it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=2.87) [interactively. This is a good way to get](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=4.4) [to know the language, as well as a useful](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=6.5) [tool for experimentation and quick testing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=8.34) [during normal development. This Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=10.370000000000001) [command‑line environment is a read, eval,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=13.07) [print loop. Python will read whatever](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=15.42) [input we type in, evaluate it, print the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=18.02) [result, and then loop back to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=20.77) [beginning. You'll often hear it referred](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=22.39) [to as simply the REPL. When started, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=24.33) [REPL will print some information about the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=28.78) [version of Python you're running, and then](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=30.52) [it will give you a triple‑arrow prompt.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=32.19) [This prompt tells you that Python is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=34.59) [waiting for you to type something. Within](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=36.05) [an interactive Python session, you can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=38.97) [enter fragments of Python programs and see](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=40.65) [instant results. Let's start with some](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=42.57) [simple arithmetic. As you can see, Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=44.53) [reads our input, evaluates it, prints the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=49.29) [result, and loops around to do the same](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=51.23) [again. We can assign the variables in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=53.29) [REPL, print their contents simply by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=56.11) [typing their name, and refer to them in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=58.59) [expressions. Within the REPL, you could](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=60.91) [use the special underscore variable to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=63.91) [refer to the most recently printed value,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=65.86) [this being one of the very few obscure](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=68.15) [shortcuts in Python, or you can use the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=70.11) [special underscore variable in an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=73.29) [expression. Remember though that this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=74.81) [useful trick only works at the REPL. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=77.56) [underscore doesn't have any special](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=79.92) [behavior in Python scripts or programs.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=81.33) [Notice that not all statements have a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=84.93) [return value. When we assigned 5 to x,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=86.5) [there was no return value, only the side](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=89.5) [effect of bringing the variable x into](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=91.58) [being. Other statements have more visible](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=93.39) [side effects. Try typing print Hello,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=95.71) [Python, at the prompt, you'll need](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=98.56) [parentheses after the print and quotes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=100.39) [around the text, then press enter. You'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=102.2) [see that Python immediately evaluates and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=105.04) [executes this command, printing the string](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=107.05) [Hello, Python and returning you to another](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=109.29) [prompt. It's important to understand that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=111.2) [the response here is not the result of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=113.55) [expression being evaluated and displayed](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=115.31) [by the REPL. Rather, it is a side effect](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=117.21) [of the print function. As an aside, print](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=119.97) [is one of the biggest differences between](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=123.13) [Python 2 and Python 3. In Python 3, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=124.73) [parentheses are required, whereas in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=127.79) [Python 2, they are not. This is because in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=129.99) [Python 3, print is a function call. More](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=132.6) [on functions later. At this point, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=135.065) [should show you how to exit the REPL and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=138.19) [get back to your system shell prompt. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=139.75) [do this by sending the end of file control](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=141.9) [character to Python. Although,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=144.01) [unfortunately, the means of sending this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=145.52) [character varies across platforms. If](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=147.23) [you're on Windows, press Ctrl+Z followed](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=150.53) [by Enter to exit. If you're on Mac or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=152.9) [Linux, press Ctrl+D to exit. If you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=156.29) [regularly switch between platforms and you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=159.3) [accidentally press Ctrl+Z on a UNIX‑like](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=161.36) [system, you will inadvertently suspended](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=163.96) [the Python interpreter and return to your](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=166.06) [operating system's shell. To reactivate](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=167.74) [Python by making it a foreground process](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=170.35) [again, simply run the fg command and press](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=172.76) [Enter a couple of times to get the triple‑arrow Python prompt back.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=2&mode=live&start=175.55)

[Significant Whitespace](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live)

[Now that you have a working Python REPL,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=1.1) [let's look at some basic code structure.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=3.05) [Start your Python 3 interpreter using the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=5.09) [Python or Python 3 command for Windows or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=7.11) [Unix‑like systems, respectively. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=9.85) [control flow structures of Python, such as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=12.68) [for loops, while loops, and if statements,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=14.65) [are all introduced by statements which are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=16.805) [terminated by a colon, indicating that the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=18.78) [body of the construct is to follow. For](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=21.04) [example, for loops require a body, so if](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=23.21) [you enter for i in range 5, Python will](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=25.86) [change the prompt to 3 dots to request you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=28.85) [provide the body. One distinctive and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=31.08) [sometimes controversial aspect of Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=34.18) [is that leading whitespace is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=36.2) [syntactically significant. What this means](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=37.5) [is that Python uses indentation levels](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=40.15) [rather than the braces used by other](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=42.28) [languages to demarcate code blocks. By](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=43.86) [convention, contemporary Python code is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=47.24) [indented by four spaces for each level, so](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=49.21) [we provide those four spaces and a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=51.7) [statement to form the body of the loop.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=53.3) [Our loop body will contain a second](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=57.14) [statement. So after pressing Return and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=58.8) [getting another three dot prompt, we'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=60.7) [enter another four spaces, followed by a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=62.552499999999995) [call to the built‑in print function. To](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=64.51) [terminate our block, we must enter a blank](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=66.97749999999999) [line into the REPL. With the block](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=68.85) [complete, Python executes the pending](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=72.22) [code, printing out the multiples of 10,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=73.56) [less than 50. Looking at a screen full of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=75.41499999999999) [Python code, we can see how the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=79.05) [indentation clearly matches and, in fact,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=80.74) [must match the structure of the program.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=82.92) [Even if we replace the code by gray lines,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=85.59) [the structure of the program is clear.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=87.93) [Each statement terminated by a colon](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=90.8) [starts a new block and introduces an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=92.68) [additional level of indentation, which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=94.4) [continues until the de‑dent restores the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=96.14) [indentation to a previous level. Each](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=98.04) [level of indent is typically four spaces,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=100.67) [although we'll cover the rules in more](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=102.84) [detail in a moment. Python's approach to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=104.53) [significant white space has three great](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=107.92) [advantages. First, it forces developers to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=109.62) [use a single level of indentation in a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=112.49) [code block. This is generally considered](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=114.28) [good practice in any language because it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=116.45) [makes code much more readable. Second,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=118.27) [code with significant whitespace doesn't](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=121.35) [need to be cluttered with unnecessary](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=123.15) [braces, and you never need to have code](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=124.73) [standard debates about where the braces](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=126.65) [should go. All code blocks in Python code](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=128.2) [are easily identifiable and everyone](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=130.78) [writes them the same way. Third,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=132.95) [significant whitespace requires that a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=135.71) [consistent interpretation must be given to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=137.39) [the structure of the code by the author,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=139.4) [the Python runtime system, and future](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=141.38) [maintainers who need to read the code. As](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=143.28) [a result, you could never have code that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=145.77) [contains a block from Python's point of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=147.53) [view, but which doesn't look like it from](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=149.06) [a cursory human perspective. The rules for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=150.88) [Python indentation can seem complex, but](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=154.93) [are straightforward in practice. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=157.22) [whitespace you use can be either tabs or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=159.21) [spaces. The general consensus is that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=161.28) [spaces are preferable to tabs, and four](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=163.84) [spaces has become a standard in the Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=165.91) [community. One essential rule is never to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=167.82) [mix spaces and tabs. The Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=170.8) [interpreter will complain, and your](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=172.77) [colleagues will hunt you down. You are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=174.18) [allowed to use different amounts of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=176.77) [indentation at different times, if you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=178.04) [wish. The essential rule is that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=179.59) [consecutive lines of code at the same](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=181.49) [indentation level are considered to be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=183.13) [part of the same code block. There are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=184.65) [some exceptions to these rules, but they](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=187.37) [almost always have to do with improving](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=189.09) [code readability in other ways, for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=190.76) [example, by breaking up necessarily long](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=192.73) [statements over multiple lines. This](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=194.94) [rigorous approach to code formatting is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=197.29) [programming as Guido intended it, or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=199.2) [indented it. This philosophy of placing a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=201.82) [high value on code qualities, such as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=204.88) [readability, gets to the very heart of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=206.67) [Python culture, something we'll take a short break to explore now.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=3&mode=live&start=208.6)

[Python Culture](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live)

[Many programming languages are at the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=1.04) [center of a cultural movement. They have](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=2.65) [their own communities, values, practices,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=4.84) [and philosophy, and Python is no](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=6.96) [exception. The development of the Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=8.55) [language itself is managed through a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=11.24) [series of documents called Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=12.77) [Enhancement Proposals, or PEPs. One of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=14.33) [PEPs, called PEP 8, explains how you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=17.33) [should format your code, and we follow its](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=19.46) [guidelines throughout this course. It is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=21.36) [PEP 8, which recommends we use 4 spaces](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=24.31) [for indentation in new Python code.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=26.41) [Another of these PEPs, called PEP 20, is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=30.14) [called The Zen of Python. It refers to 20](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=32.5) [aphorisms describing the guiding](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=35.78) [principles of Python, only 19 of which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=37.42) [have been written down. Conveniently, The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=39.55) [Zen of Python is never further away than](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=41.82) [the nearest Python interpreter as it can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=43.67) [always be accessed from the REPL by typing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=45.66) [import this. Throughout this course, we'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=47.84) [be highlighting particular nuggets of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=51.23) [wisdom from the Zen of Python in Moments](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=52.71) [of Zen, to understand how they apply to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=54.95) [what we have learned. As we've just](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=57.22) [introduced Python significant indentation,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=60.37) [this is a good time for our first Moment](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=62.64) [of Zen. Readability counts, clarity](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=64.46) [matters, so readability makes for valuable](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=68.41) [code. In time, you'll come to appreciate](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=70.99) [Python's significant whitespace for the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=74.95) [elegance it brings to your code and the ease with which you can read other's.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=4&mode=live&start=76.74)

[The Python Standard Library](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live)

[As mentioned earlier, Python comes with an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=1.14) [extensive standard library, an aspect of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=3.08) [Python often referred to as batteries](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=5.29) [included. The standard library is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=7.42) [structured as modules, a topic we'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=9.56) [discuss in depth later in this course.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=11.54) [What's important at this stage is to know](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=14.04) [that you gain access to standard library](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=15.93) [modules by using the import keyword. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=17.77) [basic form of importing a module is simply](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=21.67) [the import keyword followed by a space and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=23.76) [the name of the module. For example, let's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=26.4) [see how we can use the standard libraries](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=29.04) [math module to compute square roots. At](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=30.93) [the Triple Arrow prompt, we type import](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=33.79) [math. Since import is a statement which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=35.91) [doesn't return a value, Python doesn't](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=38.13) [print anything if the import succeeds and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=40.17) [were immediately returned to the prompt.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=42.31) [We can access the contents of the imported](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=44.84) [module by using the name of the module,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=46.57) [followed by a dot, followed by the name of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=48.47) [the attribute in the module that you need.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=50.64) [Like many object‑oriented languages, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=53.18) [dot operator is used to drill down into](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=55.01) [object structures. Being expert](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=57.2) [Pythonistas, we have inside knowledge that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=60.58) [the math module contains a function called](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=61.98) [SQRT. Let's try to use it. But how can we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=63.64) [find out what other functions are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=68.73) [available in the math module? The REPL has](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=70.29) [a special function, help, which can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=72.83) [retrieve any embedded documentation from](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=74.69) [objects for which it has been provided,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=76.76) [such a standard library modules. To get](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=78.62) [help, simply type help. We'll leave you to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=81.26) [explore the first form for interactive](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=84.53) [help on your own time. We'll go for the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=86.44) [second option and pass the math module as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=89.12) [the object for which we want help. You can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=91.12) [use the Space bar to page through the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=94.16) [help. If you're on Mac or Linux, use the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=95.64) [arrow keys to scroll up and down. Browsing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=97.77) [through the functions, we can see that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=100.63) [there is a math function for computing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=101.88) [factorials. Press Q to exit the help](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=103.63999999999999) [browser and return us to the Python REPL.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=106.02) [Practice using help to request specific](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=109) [help on the factorial function, press Q to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=110.83) [return to the REPL. Let's use the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=113.73) [factorial function, which accepts an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=116.36) [integer and returns an integer. Notice how](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=117.88) [we need to qualify the function name with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=121.01) [the name of the module containing it. This](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=122.83) [is generally good practice as it makes it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=124.82) [abundantly clear where the function is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=126.66) [coming from. That said, it can result in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=128.18) [code that is excessively verbose. To see](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=130.55) [that, let's use factorial to compute how](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=133.39) [many ways there are to draw three fruit](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=135.4) [from a set of five fruit using some math](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=137.26) [we learned in school. This simple](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=139.31) [expression is quite verbose with all those](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=142.11) [references to the math module. The Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=144.11) [import statement has an alternative form](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=146.5) [that allows us to bring a specific](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=148.37) [function from a module into the current](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=149.77) [namespace. This is a good improvement, but](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=151.46) [it's still a little long winded for such a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=154.95) [simple expression. A third form of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=156.51) [import statement allows us to rename the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=158.85) [imported function. This can be useful for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=160.61) [reasons of readability or to avoid a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=162.74) [namespace clash. Useful as it is, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=164.47) [recommend that this feature be used](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=169.31) [infrequently and judiciously. Remember](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=170.85) [that when we used factorial alone, it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=175.56) [returned an integer, but our more complex](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=177.34) [expression for combinations is returning a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=179.44) [floating point number. This is because](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=181.34) [we've used pythons floating point division](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=183.57) [operator, the single forward slash. We can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=185.48) [improve our expression since we know it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=189.24) [will only ever return integral results by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=190.87) [using Python's integer division operator,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=193.27) [which is a double forward slash. What's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=195.33) [notable is that many other programming](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=198.46) [languages would fail on the above](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=200.06) [expression for even moderate values of n.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=201.48) [In most programming languages, regular](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=203.745) [garden variety signed integers can only](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=206.15) [store values less than 2 to the 31st](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=208.07) [power. However, factorials grow so fast](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=210.08) [that the largest factorial you can fit](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=213.94) [into a 32‑bit signed integer is 12](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=215.65) [factorial since 13 factorial is too large.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=218.42) [In most widely‑used programming languages,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=221.84) [you would need more complex code or more](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=223.77) [sophisticated mathematics merely to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=225.55) [compute how many ways there are to draw 3](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=227.35) [fruit from a set of 13 fruits. Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=229.345) [encounters no such problems and can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=232.67) [compute with arbitrarily large integers](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=234.34) [limited only by the memory in your](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=236.3) [computer. Let's try the larger problem of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=237.81) [computing how many different pairs of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=240.43) [fruit we can pick from 100 different](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=241.89) [fruits assuming we can lay our hands on so](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=244.05) [much fruit. Just to emphasize how large](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=245.74) [the size of the first term in that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=249.27) [expression is, calculate 100 factorial on](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=250.57) [its own. This is a number vastly larger](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=253.3) [than even the number of atoms in the known](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=256.19) [universe with an awful lot of digits. If,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=257.77) [like me, you're curious to know exactly](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=261.58) [how many digits, we can convert our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=263.44) [integer to a text string and count the number of characters in it like this.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=5&mode=live&start=265.26)

[Summary](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live)

[Congratulations! You've taken your first](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=2.08) [steps in Python, and you're well on your](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=3.02) [way to reading and writing much more](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=4.59) [sophisticated Python programs. In this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=6.12) [module, we saw how to download and install](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=9.15) [Python on Windows, Linux and macOS. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=11.51) [covered starting your Python REPL. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=14.92) [evaluated some simple expressions in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=17.67) [REPL. We learned that in the REPL, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=19.5) [underscore symbol is bound to the result](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=22.59) [of the last evaluated expression. We saw](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=24.36) [how to make basic use of the print](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=27.62) [function, and we learned that the printed](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=29.11) [output is a side effect of the function,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=31.05) [not a return value. We saw how to exit the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=32.94) [REPL using Ctrl+Z on Windows and Ctrl+D on](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=36.36) [Linux and macOS. We were introduced to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=39.24) [Python's use of significant whitespace. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=42.38) [learned that code blocks in python are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=45.27) [initiated with a colon and comprise](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=46.93) [consecutive lines at the same indentation](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=48.76) [level. We looked at some of the advantages](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=50.66) [of significant whitespace, including](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=53.31) [clarity and consistency. We covered the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=54.92) [basic rules for indentation in Python. On](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=57.37) [a less technical level, we covered some](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=60.49) [parts of Python's culture. We looked at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=62.17) [the Zen of Python and saw that it could be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=64.32) [printed by executing import this in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=66.05) [REPL, and we looked specifically at the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=68.2) [idea that readability counts when writing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=70.72) [Python code. We covered the basics of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=72.83) [importing modules from the standard](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=75.62) [library, and we saw three forms of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=77.01) [import statement, importing an entire](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=79.6) [module, importing selected elements of a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=81.56) [module, and renaming imported elements. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=83.55) [saw how to use Python's help system. Along](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=86.88) [the way, we saw how to use the factorial](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=90.09) [function from Python's standard math](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=92.33) [library. In the next module of Core](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=94.17) [Python: Getting Started, we'll look at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=96.77) [Python's fundamental scalar types,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=98.74) [integers, floats, nones, and bools, as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=100.27) [well as some basic flow control constructs.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=bec2fe0b-c987-4136-87c7-3b3f42c01a0c&clip=6&mode=live&start=103.23)

[Scalar Types, Operators, and Control Flow](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live)

[Overview](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live)

[Now that you've got a functional Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=1.09) [REPL on your system, we can start to work](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=2.71) [with the fundamentals of the language. In](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=4.62) [this module of Core Python: Getting](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=6.62) [Started, you'll start to learn about](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=8.11) [Python's fundamental scalar types. We'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=10.09) [look at basic use of relational operators,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=12.67) [and we'll introduce basic flow‑control](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=15.81) [mechanisms. Python comes with a number of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=17.4) [built‑in data types. These include](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=21.39) [primitive scalar types like integers, as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=23.34) [well as collection types like](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=25.38) [dictionaries. These built‑in types are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=26.81) [powerful enough to be used alone for many](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=28.91) [programming needs, and they can be used as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=30.71) [building blocks for creating more complex](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=32.74) [data types. In this section, we cover the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=34.56) [basic scalars, int for whole numbers;](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=37.71) [float for numbers with fractional parts;](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=40.54) [None, an important placeholder value; and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=43.08) [bool, used for True and False values.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=46.04) [We'll provide basic information about](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=49.84) [these now, showing their literal forms and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=51.49) [how to create them. We've already seen](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=53.41) [quite a lot of Python integers in action.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=56.94) [Python integers are signed, and have, for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=59.15) [all practical purposes, unlimited](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=61.12) [precision, meaning they can contain as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=62.78) [many digits as you need. Integer literals](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=64.64) [in Python are specified in decimal, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=68.1) [may also be specified in binary with the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=70.29) [0b prefix, in octal with the 0o prefix, or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=72.32) [in hexadecimal with the 0x prefix. We can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=76.66) [also construct integers by a call to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=80.45) [int constructor. This can convert from](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=82.24) [other numeric types, such as floats, to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=84.36) [integers. Note that the rounding of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=86.2) [integers is always towards zero. The int](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=88.95) [constructor can also convert strings to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=92.35) [integers. You can even supply an optional](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=94.17) [number base when converting from a string.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=97.15) [For example, to convert from base 3,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=99.49) [provide the value 3 as the second argument](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=101.6) [to the int constructor. Floating point](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=103.74) [numbers are supported in Python by the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=107.33) [float type. Python floats are implemented](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=109.04) [as IEEE‑754 double‑precision floating](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=111.61) [point numbers with 53 bits of binary](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=114.35) [precision. This is equivalent to between](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=116.33) [15 and 16 significant digits in decimal.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=118.44) [Any literal number containing a decimal](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=122.13) [point is interpreted by Python as a float.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=123.81) [Scientific notation can be used, so for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=127.24) [large numbers, such as the approximate](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=129.27) [speed of light in meters per second, 3](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=130.94) [times 10 to the eighth, we can write 3e8,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=132.81) [and for small numbers like Planck's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=136.64) [constant, 1.616 times 10 to the negative](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=138.06) [thirty‑fifth, we can enter 1.616e‑35.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=140.73) [Notice how Python automatically switches](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=146.42) [the display representation, that is, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=148.21) [format it prints to the REPL, to the most](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=150.21) [readable form. As with integers, we can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=152.14) [convert to floats from other numeric or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=155.29) [string types using the float constructor.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=157.06) [We can pass int values to the float](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=159.03) [constructor, and we can pass strings. This](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=161.17) [is also how we create the special floating](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=164.59) [point values nan, or not a number, as well](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=166.27) [as positive infinity and negative](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=169.34) [infinity. One important rule to remember](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=171.19) [is that the result of any calculation](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=174.83) [involving int and float is promoted to a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=176.52) [float. You can read more about Python's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=178.82) [number types in Python's documentation.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=181.31) [Python has a special null value called](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=185.44) [None, spelled with a capital N. None is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=187.44) [frequently used to represent the absence](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=190.42) [of a value. The Python REPL never prints](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=192.2) [None results, so typing None into the REPL](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=194.57) [has no effect. None could be bounded to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=196.97) [variable names just like any other object,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=199.79) [and we can test whether an object is None](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=202.04) [by using Python's is operator. We can see](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=203.72) [here that the result of the is operator in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=207.09) [this case is True, which brings us](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=208.9) [conveniently onto the bool type. The bool](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=210.59) [type represents logical states, and plays](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=214.75) [an important role in several of Python's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=216.61) [control flow structures, as we'll see](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=218.3) [shortly. As you probably expect, there are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=220.45) [two bool values, True and False, both](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=223.18) [spelled with initial capitals. There is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=225.79) [also a bool constructor which can be used](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=228.75) [to convert from other types to bool. Let's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=230.55) [look at how it works. For integers, zero](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=232.7) [is considered Falsy and all other values](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=235.8) [Truthy. We see the same behavior with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=238.135) [floats, where only zero is considered](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=240.97) [Falsy. When converting from collections,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=242.73) [such as strings or lists, only empty](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=245.67) [collections are treated as Falsy. For](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=247.79) [lists, which we'll look at shortly, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=249.94) [empty list is Falsy, while any non‑empty](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=251.99) [list is Truthy. Similarly, empty strings](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=254.65) [are Falsy, while any other strings are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=257.88) [Truthy. It's worth noting that the bool](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=259.83) [constructor may not behave as you expect](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=263.15) [when passing in the strings True and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=265.05) [False. Since both are non‑empty strings,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=266.67) [both result in True. These conversions to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=269.235) [bool are important, because they are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=272.33) [widely used in Python if statements and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=273.82) [while loops, which accept bool values into](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=275.82) [the condition. We'll look at these constructs soon.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=0&mode=live&start=277.83)

[Relational Operators](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live)

[Bool values are commonly produced by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=1.04) [Python's relational operators, which can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=2.78) [be used for comparing objects. These](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=4.62) [include value equality or equivalents,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=7.41) [value inequality or inequivalence, less](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=10.19) [than, greater than, less than or equal to,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=12.97) [and greater than or equal to. Two of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=16.38) [most widely used relational operators are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=19.64) [Python's equality and inequality tests.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=21.6) [These test whether two objects are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=24.32) [equivalent or inequivalent, that is,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=25.87) [whether one can be used in place of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=28.12) [other or not. We'll learn more about the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=29.66) [notion of object equivalents later in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=31.98) [course, but for now, we'll just compare](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=33.8) [simple integers. Let's start by assigning](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=35.59) [or binding a value to the variable g. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=38.92) [test for equality with the == operator,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=42.53) [and we test for inequality using the not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=46.01) [equals operator, an exclamation point](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=48.14) [followed by an equal sign. We can also](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=50.19) [compared the order of quantities using the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=53.08) [rich comparison operators. We check if one](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=54.88) [object is less than another with the less](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=57.63) [than operator. We can append an equal sign](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=59.6) [to this operator to test for less than or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=62.45) [equal. Likewise, we check if an object is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=64.32) [greater than another with the greater than](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=67.42) [operator, and as with less than, there is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=69.04) [the related greater than or equal operator.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=1&mode=live&start=72.54)

[Control Flow](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live)

[Now that we've examined some basic](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=1.09) [built‑in types, we'll look at two](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=2.62) [important control flow structures, which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=4.05) [depend on the conversions to the bool](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=5.8) [type, if statements and while loops. We'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=7.94) [start with if statements, also known as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=10.51) [conditional statements. Conditional](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=12.31) [statements allow us to branch execution](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=14.95) [based on the value of an expression. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=16.77) [form of the statement is the if keyword,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=18.94) [followed by an expression, terminated by a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=20.98) [colon to introduce a new block. Let's try](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=23.09) [this at the REPL. Remembering to indent](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=26.23) [four spaces within the block, we add some](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=28.94) [code to be executed if the condition is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=30.91) [true. We terminate the blocked by entering](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=32.7) [a blank line. Because the condition is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=35.56) [self‑evidently true, the block executes,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=38.36) [and we see the string, It's true!, printed](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=40.63) [to the REPL. Conversely, if the condition](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=42.51) [is false, the code in the block does not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=45.56) [execute. The expression used with the if](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=47.42) [statement will be converted to a bool,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=50.33) [just as if the bool constructor had been](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=52.01) [used, so explicitly constructing a bool in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=53.66) [the if statement is exactly equivalent to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=56.01) [using a bare string. Thanks to this useful](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=58.03) [shorthand, explicit conversion to bool](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=60.85) [using the bool constructor is rarely used](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=62.84) [in Python. The if statement supports the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=64.73) [optional else‑claus that goes in a block](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=68.47) [introduced by the else keyword followed by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=70.94) [colon, which is indented to the same level](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=73.11) [as the if keyword. To start the else](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=75.29) [block, in this case, we just omit the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=78.1) [indentation after the three dots. For](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=79.69) [multiple conditions, you might be tempted](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=83.6) [to nest if statements inside else blocks](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=85.35) [like this. Whenever you find yourself](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=87.16) [doing this though, you should consider](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=90.91) [using Python's lf keyword, which is a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=92.37) [combined else‑if. As the Zen of Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=94.35) [reminds us, flat is better than nested. This version is altogether easier to read.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=2&mode=live&start=97.11)

[While-loops](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live)

[Python has two types of loop, for loops](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=1.04) [and while loops. We've already briefly](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=3.57) [introduced for loops back when we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=5.78) [introduced significant white space, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=7.14) [we'll return to them soon, but right now](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=8.96) [we'll cover for loops. While loops in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=10.84) [Python are introduced by the while](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=13.44) [keyword, which is followed by a Boolean](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=15.32) [expression. As with the condition for if](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=16.98) [statements, the expression is implicitly](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=19.3) [converted to a Boolean value, as if it had](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=21.19) [been passed to the bool constructor. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=23.21) [while statement is terminated by a colon](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=25.68) [because it introduces a new block. Let's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=27.58) [write a loop at the REPL, which counts](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=30.77) [down from 5 to 1. We'll initialize a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=32.22) [counter variable called C to 5, and keep](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=34.31) [looping until we reach zero. Another new](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=37.03) [language feature here is the use of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=40) [augmented assignment operator, a minus](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=41.63) [sign followed by an equal sign to subtract](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=43.7) [one from the value of C on each iteration.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=46.04) [Similar augmented assignment operators](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=49.24) [exist for other basic math operators, such](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=50.95) [as plus and multiply. Because the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=53) [condition, also called the predicate, will](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=55.61) [be implicitly converted to bool, just as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=57.47) [if a call to the bool constructor present,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=59.67) [we could replace the above code with the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=61.67) [following version. This works because the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=63.39) [conversion of the integer value of C to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=67.43) [bool results in true until we get to zero,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=69.58) [which converts to false. That said, to use](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=71.83) [this short form in this case might be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=74.73) [described as unPythonic because, referring](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=76.22) [back to the Zen of Python, explicit is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=78.71) [better than implicit, and we place a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=80.71) [higher value on the readability of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=82.48) [first form over the concision of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=84.1) [second form. While loops are often used in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=85.76) [Python, where an infinite loop is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=89.33) [required. We achieve this by simply](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=91.18) [passing true as the predicate expression](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=92.94) [to the while construct. Now you're](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=94.73) [probably wondering how to get out of this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=97.67) [loop and regain control of your REPL. To](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=99.05) [do this, we press Ctrl+C. Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=101.25) [intercepts this to raise a special](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=104.24) [exception which terminates the loop. We'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=105.69) [be talking much more about what exceptions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=107.98) [are and how to use them later in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=109.74) [course. Many programming languages support](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=111.27) [a loop construct which places the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=115.29) [predicate test at the end of the loop](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=116.69) [rather than at the beginning. For example,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=118.29) [C, C++, C #, and Java support the do while](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=120.47) [construct. Other languages have repeat](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=123.84) [until loops instead or as well. This is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=126.32) [not the case in Python, where the idiom is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=129.07) [to use, while true, together with an early](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=131.07) [exit facilitated by the break statement,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=133.17) [the break statement jumps out of the loop](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=136.34) [and only the innermost loop, if several](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=138.02) [loops have nested, and then continues](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=139.72) [execution immediately after the loop body.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=141.63) [Let's look at an example of break,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=144.87) [introducing a few other Python features](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=147.44) [along the way. We start with a while true](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=149.06) [for an infinite loop. On the first](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=151.69) [statement of the while block, we used the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=154.24) [built in input function to request a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=155.72) [string from the user. We assigned that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=157.55) [string to a variable called response. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=159.6) [now use an if statement to test whether](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=162.86) [the value provided is divisible by seven.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=164.5) [We convert response to an integer, using](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=167.14) [the int constructor and then use the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=168.99) [modulus operator, the percent symbol to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=170.63) [divide by 7 and give the remainder. If the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=172.97) [remainder is equal to 0, the response was](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=175.63) [divisible by 7, and we enter the body of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=177.67) [the if block. Within the if block, now two](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=179.64) [levels of indentation deep, we start with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=182.83) [eight spaces and use the break keyword.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=185) [Break terminates the innermost loop, in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=187.1225) [this case the while loop, and causes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=189.26) [execution to jump to the first statement](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=191.08) [after the loops. In our case, this is the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=192.72) [end of the program. Enter a blank line](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=195.2) [that the three dots prompt to close both](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=197.32) [the if block and the while block. Our loop](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=199.095) [will start executing and will pause at the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=202.05) [call to the input function waiting for us](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=203.71) [to enter a number. Let's try a few. As](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=205.48) [soon as we enter a number divisible by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=209.69) [seven, the predicate becomes true. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=211.21) [enter the if block and then literally](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=213.36) [break out of the loop, ending the program and returning us to the REPL prompt.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=3&mode=live&start=215.02)

[Summary](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live)

[We've covered quite a bit of ground in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=1.04) [this module, so let's summarize what we've](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=2.37) [seen. We looked at the four built‑in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=4.2) [scalar types, int, float, none, and bool,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=6.96) [and conversions between these types, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=10.55) [use of their literal forms. We looked at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=12.36) [six relational operators used for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=15.19) [equivalents and ordering. We demonstrated,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=17.03) [structuring conditional code with the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=19.83) [if‑elif‑else structures. We showed](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=21.42) [iterating with while loops, and we saw how](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=24.98) [the condition expression of the while loop](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=27.6) [is implicitly converted to a bool. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=29.235) [looked at how to intercept infinite loops](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=31.98) [with Ctrl+C, and we learned that doing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=33.66) [this generates a keyboard interrupt](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=36.47) [exception. We gave an example of how to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=38.09) [break out of loops using the break](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=40.95) [statement. We observed that break only](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=42.43) [breaks us out of the innermost nested loop](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=45.35) [and that it takes us to the first](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=48.24) [statement immediately following the loop.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=49.35) [Along the way, we looked at the augmented](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=52.04) [assignment operators for modifying](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=53.88) [objects, such as counter variables in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=55.59) [place. We also looked at requesting text](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=57.35) [from the user with the built‑in input](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=60.3) [function. In the next module of Core](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=61.8) [Python: Getting Started, we'll continue](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=65.58) [our exploration of Python's built‑in types](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=67.31) [and control flow structures by looking at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=69.36) [strings, lists, dictionaries, and for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=71.08) [loops. We'll even be using Python to fetch some data from the web for processing.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=43f23f6d-a3ab-4f26-8cd3-cf04abfaf6e2&clip=4&mode=live&start=73.85)

[Introducing Strings, Collections, and Iteration](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=0&mode=live)

[Overview](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=0&mode=live)

[Now that you have an initial understanding](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=0&mode=live&start=1.04) [of Python's fundamental scaler types,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=0&mode=live&start=2.7) [you're ready to start exploring some of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=0&mode=live&start=4.7) [the collection types. In this module of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=0&mode=live&start=6.23) [Core Python: Getting Started, we'll look](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=0&mode=live&start=9.02) [at a few of the most important collection](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=0&mode=live&start=10.9) [types in Python, str, bytes, list, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=0&mode=live&start=12.47) [dict. We'll introduce you to the for loop,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=0&mode=live&start=15.98) [a looping construct commonly used for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=0&mode=live&start=18.96) [iterating over collections. We'll apply](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=0&mode=live&start=20.74) [all of this to build a small, but useful](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=0&mode=live&start=23.56) [program that demonstrates the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=0&mode=live&start=25.36) [expressiveness of Python. Python includes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=0&mode=live&start=26.74) [a rich selection of collection types,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=0&mode=live&start=30.69) [which are often completely sufficient for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=0&mode=live&start=32.31) [even quite intricate programs without](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=0&mode=live&start=34.09) [resorting to defining your own data](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=0&mode=live&start=35.97) [structures. We'll give enough of an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=0&mode=live&start=37.44) [overview of some fundamental collection](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=0&mode=live&start=39.98) [types now to allow us to write some](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=0&mode=live&start=41.62) [interesting code. We'll also be revisiting](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=0&mode=live&start=43.2) [each of these collection types together](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=0&mode=live&start=46) [with a few additional ones later in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=0&mode=live&start=47.62) [course. Let's start with these types, str,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=0&mode=live&start=49.33) [bytes, list, and dict. Along the way, we'll also cover Python's for loops.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=0&mode=live&start=53.94)

[String](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live)

[Strings in Python have the data type str,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=1.04) [spelled s‑t‑r, and we've been using them](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=3.54) [extensively already. Strings are sequences](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=5.99) [of Unicode code points, and for the most](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=8.59) [part, you can think of code points as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=10.58) [being like characters, although they are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=12) [not strictly equivalent. The sequence of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=13.61) [characters in a Python string is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=16.92) [immutable, meaning that once you've](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=18.34) [constructed a string, you can't modify its](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=19.91) [contents. Literal strings in Python are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=22.04) [delimited by quotes, you could use single](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=25.035) [quotes or double quotes. You must,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=27.3) [however, be consistent. For example, you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=31.28) [can't use single quotes on one side and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=34.13) [double on the other, like this. Supporting](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=36.07) [both quoting styles allows you to easily](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=40.19) [incorporate the other quote character into](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=42.11) [the literal string without resorting to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=44) [ugly escape character gymnastics. Notice](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=45.58) [that the REPL exploits the same, quoting](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=48.1475) [flexibility when echoing the strings back](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=50.37) [to us. Beautiful text strings rendered in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=52.32) [literal form, simple elegance. At first](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=61.48) [sight, support for both quoting styles](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=65.99) [seems to violate an important principle of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=67.63) [Pythonic style from the Zen of Python.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=69.64) [There should be one, and preferably only](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=72.07) [one, obvious way to do it. In this case,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=74.11) [however, another aphorism from the same](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=77.33) [source, practicality beats purity, takes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=79.45) [precedence. The utility of supporting two](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=82.21) [quoting styles is valued more highly than](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=85.46000000000001) [the alternative, a single quoting style](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=87.39) [combined with more frequent use of ugly](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=89.43) [escape sequences, which we'll encounter shortly.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=1&mode=live&start=91.24)

[String Literals](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live)

[Adjacent literal strings are concatenated](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=1.08) [by the Python compiler into a single](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=2.98) [string, which, although at first it seems](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=4.62) [rather pointless, can be useful for a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=6.59) [nicely formatted code, as we'll see later.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=8.34) [If you want a literal string containing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=11.41) [newlines, you have two options, use](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=12.93) [multiline strings or use escape sequences.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=15.31) [First, let's look at multiline strings.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=19.44) [Multiline strings are delimited by three](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=22.14) [quote characters rather than one. Here's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=24.01) [an example using three double quotes.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=26.41) [Notice how, when the string is echoed back](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=29.21) [to us, the newlines are represented by the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=31.09) [\n escape sequence. We can also use three](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=32.93) [single quotes. As an alternative to using](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=36.93) [multiline quoting, we can just embed the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=40.11) [control characters ourselves. To get a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=42.04) [better sense of what we're representing,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=44.39) [we can use print to see the string. If](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=45.785) [you're working on Windows, you might be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=50.15) [thinking that newlines should be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=51.69) [represented by the carriage return and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=52.89) [newline couplet \r\n. There's no need to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=54.48) [do that with Python. Since Python 3 has a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=58.55) [feature called Universal Newline Support,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=60.5) [which translates from the simple \n to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=62.63) [native newline sequence for your platform](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=65.32) [on input and output. You can read more](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=67.15) [about Universal Newline Support in PEP](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=69.87) [278. We can use the escape sequences for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=71.73) [other purposes, too, such as incorporating](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=76.42) [tabs with \t or allowing us to quote](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=78.31) [characters within strings by using \](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=81) [double quote or \ single quote. See how](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=83.13499999999999) [Python is smarter than we are at using the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=87.51) [most convenient quote delimiters, although](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=89.27) [Python will also resort to escape](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=91.35) [sequences when we use both types of quotes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=92.93) [in a string. Because backslash has special](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=94.9) [meaning, to place a backslash in a string,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=99.02) [we escape the backslash with itself. To](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=100.87) [reassure ourselves that there really is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=104.04) [only one backslash in that string, we can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=105.75) [print it. You can read more about escape](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=107.82) [sequences in the Python documentation at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=111.51) [python.org. Sometimes, particularly when](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=113.49) [dealing with strings such as Windows file](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=118.01) [system paths or regular expression](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=120.07) [patterns, which use backslashes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=121.79) [extensively, the requirement to double up](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=123.525) [on backslashes can be ugly and error](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=125.47) [prone. Python comes to the rescue with its](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=127.26) [raw strings. Raw strings don't support any](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=130.41) [escape sequences and are very much what](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=133.12) [you see is what you get. To create a raw](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=135.09) [string, prefix the opening quote with a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=137.49) [lowercase r. We can use the string](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=139.64) [constructor to create string](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=143.89) [representations of other types such as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=145.18) [integers or floats. Strings in Python are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=147.07) [what are called sequence types, which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=151.65) [means they support certain common](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=153.35) [operations for querying sequences. For](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=154.73) [example, we can access individual](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=157.4) [characters using square brackets with an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=159.25) [integer 0‑based index. Note that in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=161.05) [contrast to many programming languages,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=164.3) [there is no separate character type](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=166.19) [distinct from the string type. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=167.71) [indexing operation we just used returns a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=169.9) [full‑blown string that contains a single](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=172.03) [character element, something we can test](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=174) [using Python's built‑in type function.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=175.96) [There will be more on types and classes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=178.98) [later in the course. String objects also](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=180.63) [support a wide variety of operations](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=184.84) [implemented as methods. We can list those](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=186.69) [methods using help on the string type.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=189.98) [Ignore all the hieroglyphics with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=192.89) [underscores for now and page down until](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=194.28) [you see the documentation for the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=196.33) [capitalized method. Press Q to quit the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=197.66) [help browser, and we'll try to use that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=200.21) [method. First, let's make a string that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=201.89) [deserves capitalization, the proper noun](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=204.68) [of a capital city, no less. To call](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=206.68) [methods on objects in Python, we use the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=209.18) [dot after the object name and before the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=210.99) [method name. Methods are functions, so we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=212.83) [must use the parentheses to indicate that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=215.17) [the method should be called. Remember that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=216.97) [strings are immutable, so the capitalized](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=219.85) [method didn't modify c in place, rather,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=221.73) [it returned a new string. We can verify](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=224.49) [this by displaying c, which remains](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=226.67) [unchanged. You might like to spend a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=228.82) [little time familiarizing yourself with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=231.46) [the various useful methods provided by the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=233.26) [string type. Finally, because strings are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=235) [fully Unicode capable, we can use them](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=239.11) [with international characters easily, even](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=241.29) [in literals because the default source](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=243.39) [code encoding for Python 3 is UTF‑8. For](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=245.27) [example, if you have access to Norwegian](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=249.68) [characters, you can simply enter this.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=251.65) [Alternatively, you can use the hexidecimal](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=254.71) [representations of Unicode code points as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=256.99) [an escape sequence prefixed by \u, which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=259.06) [I'm sure you'll agree, is somewhat more](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=262.13) [unwieldy. Similarly, you can use the \x](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=264.14) [escape sequence, followed by a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=268.4) [two‑character hexidecimal string or an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=269.82) [escaped octal string to include Unicode](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=272.39) [characters in a string literal. There are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=274.74) [no such Unicode capabilities in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=277.55) [otherwise similar bytes type, which we'll look at next.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=2&mode=live&start=279.43)

[Bytes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live)

[Bytes are very similar to strings, except](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=1.04) [that rather than being sequences of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=3.16) [Unicode code points, they are sequences](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=4.7) [of, well, bytes. As such, they are used](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=6.7) [for raw binary data and fixed‑width](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=9.91) [single‑byte character encodings such as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=11.78) [ASCII. As with strings, they have a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=13.61) [simple, literal form using quotes, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=16.34) [first of which is prefixed by a lower case](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=18.61) [b. There is also a bytes constructor, but](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=20.68) [it's an advanced feature and we won't](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=24.02) [cover it in this fundamentals course. At](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=25.48) [this point, it's sufficient for us to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=28.1) [recognize bytes literals, and understand](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=29.53) [that they support most of the same](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=31.5) [operations as string, such as indexing,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=32.93) [which returns the integer value of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=35.26) [specified byte, and splitting, which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=36.82) [you'll see returns a list of bytes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=39.07) [objects. To convert between bytes and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=40.63) [strings, we must know the encoding of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=44.75) [byte sequence used to represent the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=46.61) [string's Unicode code points as bytes.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=48.24) [Python supports a wide variety of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=51.57) [encodings, a full list of which can be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=53.19) [found at python.org. Let's start with an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=54.93) [interesting Unicode string which contains](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=58.1) [all the characters of the 29‑letter](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=59.9) [Norwegian alphabet, a pangram. We'll now](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=61.71) [encode that using UTF‑8 into a bytes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=65.025) [object. See how the Norwegian characters](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=67.34) [have each been rendered as pairs of bytes.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=70.63) [We can reverse that process using the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=73.8) [decode method of the bytes object. Again,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=75.55) [we must supply the correct encoding. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=78.92) [can check that the result is equal to what](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=81.91) [we started with, and display it for good](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=83.51) [measure. This may seem like an unnecessary](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=85.25) [detail so early in the course, especially](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=88.53) [if you operate in an anglophone](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=90.74) [environment, but it's a crucial point to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=92.07) [understand since files and network](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=94.19) [resources such as HTTP responses are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=96.47) [transmitted as byte streams, whereas we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=98.82) [often prefer to work with the convenience of Unicode strings.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=3&mode=live&start=101.03)

[List](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live)

[Python lists, such as those returned by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=1.04) [the string split method are sequences of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=3.24) [objects. Unlike strings, lists are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=5.64) [mutable, insofar as the elements within](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=8.39) [them can be replaced or removed, and new](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=10.49) [elements can be inserted or appended.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=12.55) [Lists are a workhorse of Python data](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=14.73) [structures. Literal lists are delimited by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=17.14) [square brackets, and the items within the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=21.42) [list separated by commas. Here is a list](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=23.33) [of three numbers and a list of three](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=25.73) [strings. We can retrieve elements by using](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=28.67) [square brackets with a zero‑based index,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=31.9) [and we can replace elements by assigning](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=34.94) [to a specific element. See how lists can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=36.73) [be heterogeneous with respect to the types](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=39.84) [of the objects. We now have a list](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=41.75) [containing a string, an integer, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=43.84) [another string. It's often useful to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=45.78) [create an empty list, which we can do](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=48.87) [using empty square brackets. We can modify](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=50.39) [the list in other ways. Let's add some](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=54.03) [floats to the end of the list using the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=55.94) [append method. There are many other useful](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=57.66) [methods for manipulating lists, which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=61.29) [we'll cover in a later module. There's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=63.1) [also a list constructor, which can be used](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=65.77) [to create lists from other collections](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=67.73) [such as strings. Finally, although the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=69.215) [significant whitespace rules in Python can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=73.08) [at first seem very rigid, there is a lot](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=74.95) [of flexibility. For example, if at the end](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=77.17) [of the line brackets, braces or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=80.47) [parentheses are unclosed, you can continue](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=82.23) [on the next line. This can be very useful](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=84.66) [for long, literal collections, or simply](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=87.87) [to improve readability. See also how we're](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=89.75) [allowed to use an additional comma after](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=93.6) [the last element. This is an important maintainability feature.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=4&mode=live&start=95.5)

[Dict](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live)

[Dictionaries are completely fundamental to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live&start=1.04) [the way the Python language works and are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live&start=3.02) [very widely used. A dictionary maps keys](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live&start=4.79) [to values, and in other languages, is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live&start=7.76) [known as a map or an associative array.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live&start=9.64) [Let's look at how to create and use them](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live&start=12.44) [in Python. Literal dictionaries are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live&start=13.765) [created using curly braces containing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live&start=16.9) [key‑value pairs. Each pair is separated by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live&start=18.73) [a comma, and each key is separated from](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live&start=22.27) [the corresponding value by a colon. Here,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live&start=24.26) [we use a dictionary to create a simple](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live&start=28.3) [telephone directory. We can retrieve items](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live&start=29.93) [by key using the square brackets operator](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live&start=32.94) [and update the values associated with the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live&start=36.14) [key by assigning through the square](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live&start=37.89) [brackets. If we assign to a key that has](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live&start=39.47) [not yet been added, a new entry is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live&start=42.97) [created. Be aware that in Python versions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live&start=44.78) [prior to 3.7, the entries in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live&start=48.43) [dictionary can't be relied upon to be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live&start=50.61) [stored in any particular order. As of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live&start=52.33) [Python 3.7, however, entries are required](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live&start=54.67) [to be kept in insertion order. Similarly,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live&start=57.2) [to lists, empty dictionaries can be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live&start=61.07) [created using empty curly braces. We'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live&start=62.95) [revisit dictionaries in much more detail in a later module](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=5&mode=live&start=66.86)

[For-loop](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=6&mode=live)

[Now that we have the tools to make some](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=6&mode=live&start=1.04) [interesting data structures, we'll look at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=6&mode=live&start=2.56) [Python's second type of loop construct,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=6&mode=live&start=4.82) [the for loop. For loops in Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=6&mode=live&start=6.199999999999999) [correspond to what are called for each](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=6&mode=live&start=9.27) [loops in many other programming languages.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=6&mode=live&start=11.31) [They request items one by one from a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=6&mode=live&start=14.33) [collection, or more strictly, from an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=6&mode=live&start=16.03) [iterable series, but more on that later,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=6&mode=live&start=18.13) [and assign them in turn to a variable that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=6&mode=live&start=20.11) [we specify. Let's create a collection and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=6&mode=live&start=22.17) [use a for loop to iterate over it. If you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=6&mode=live&start=26.4) [iterate over dictionaries, you get the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=6&mode=live&start=30.16) [keys, which you can then use within the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=6&mode=live&start=31.92) [for loop body to retrieve values. Here we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=6&mode=live&start=33.81) [define a dictionary mapping string color](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=6&mode=live&start=37.02) [names to hexadecimal integer color codes.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=6&mode=live&start=38.89) [Note that we used the ability of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=6&mode=live&start=42.82) [built‑in print function to accept multiple](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=6&mode=live&start=44.27) [arguments. We passed the key and the value](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=6&mode=live&start=46.19) [for each color separately. See also how](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=6&mode=live&start=48.62) [the color codes returned to us are in decimal.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=6&mode=live&start=51.62)

[Putting it all Together](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live)

[In this last section, before we summarize,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=1.08) [we're going to write a longer snippet at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=3.3) [the REPL. We're going to fetch some text](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=5.04) [data for some classic literature from the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=7.23) [web using a Python standard library](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=8.94) [function called urlopen. To get access to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=10.85) [urlopen, we need to import the function](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=14.2) [from the request module within the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=16.37) [standard library urllib package. Next,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=17.93) [we're going to call urlopen with a URL to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=21.89) [our story, then create an empty list,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=24.19) [which ultimately will hold all of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=27.48) [words from the text. Next, we open a for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=29.06) [loop, which will work through the story.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=32.99) [Recall that for loops request items one by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=35.71) [one from the term on the right of the in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=37.97) [keyword, in this case, story, and assign](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=39.92) [them in turn to the name on the left, in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=42.97) [this case, line. It so happens that the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=45.02) [type of HTTP response represented by story](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=48.71) [yields successive lines of text when](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=51.56) [iterated over in this way. So the for loop](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=53.43) [retrieves one line of text a time from](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=55.94) [Dickens' classic. Note also that the for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=57.88) [statement is terminated by a colon because](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=61.3) [it introduces the body of the for loop,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=63.46) [which is a new block and hence a further](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=65.43) [level of indentation. For each line of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=67.29) [text, we used the split method to divide](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=70.14) [it into words on whitespace boundaries,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=72.27) [resulting in a list of words we call line](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=74.21) [words. Now, we use a second for loop](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=76.41) [nested inside the first to literate over](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=79.64) [this list of words, appending each in turn](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=81.58) [to the accumulating story words list. Now,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=84.05) [we enter a blank line at the three dots](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=87.79) [prompt to close all open blocks. In this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=89.56) [case, the inner for loop and the outer for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=91.92) [loop will both be terminated. The block](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=93.755) [will be executed, and after a short delay,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=96.39) [Python now returns us to the regular](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=98.67) [triple‑arrow prompt. At this point, if](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=100.4) [Python gives you an error, such as a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=103.92) [syntax error or indentation error, you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=105.49) [should go back, review what you entered,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=107.92) [and carefully re‑enter the code until](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=110.13) [Python accepts the whole block without](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=111.95) [complaint. If you get an HTTP error, then](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=113.6) [you were unable to fetch the resource over](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=117.02) [the internet, and you should try again](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=118.68) [later, although it's worth checking that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=120.42) [you typed the URL correctly. Finally, now](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=122.19) [that we're done reading from the URL, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=125.63) [need to close our handle to it, story. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=127.41) [can look at the words we read simply by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=130.44) [asking Python to evaluate the value of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=131.97) [story words. Here, we can see the list of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=133.97) [words. Notice that each of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=136.95) [single‑quoted words is prefixed by a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=139.37) [lowercase letter B, meaning that we have a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=141.14) [list of bytes objects where we would have](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=143.37) [preferred a list of strings. This is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=145.16) [because the HTTP request transferred raw](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=147.72) [bytes to us over the network. To get a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=150.21) [list of strings, we should decode the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=152.69) [bytes string each line into Unicode](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=154.44) [strings. We can do this by inserting a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=156.26) [call to the decode method of the bytes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=159.32) [object and then operating on the resulting](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=161.31) [Unicode string. The Python REPL supports a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=163.31) [simple command‑line history, and by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=166.97) [careful use of the up and down‑arrow keys,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=168.91) [we can re‑enter our snippet. When we get](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=170.96) [to the line which needs to be changed, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=174.41) [can edit it using the left and right‑arrow](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=176.34) [keys to insert the requisite call to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=178.28) [decode. Then when we rerun the block and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=179.92) [take a fresh look at story words, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=184.09) [should see we have a list of strings.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=185.96) [We've just about reached the limits of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=189.84) [what's possible to comfortably edit at the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=191.46) [Python REPL. So in the next course module,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=193.18) [we'll look at how to move this code into a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=195.69) [Python module where it can be more easily worked with in a text editor.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=7&mode=live&start=197.24)

[Summary](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live)

[There are a lot of details in this module,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=1.04) [which may be difficult to remember all at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=3) [once, but which you'll find you use very](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=4.74) [frequently when writing Python code.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=6.89) [First, we looked at strings, in particular](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=8.63) [the various forms of quoting for single](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=10.94) [and multi‑line strings. We saw how](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=12.69) [adjacent string literals are implicitly](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=15.65) [concatenated. Python has support for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=17.265) [universal newlines. So no matter what](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=20.44) [platform you're using, it's sufficient to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=22.4) [use a single backslash n character, safe](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=24.21) [in the knowledge that it will be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=26.83) [appropriately translated from and to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=27.83) [native newline during IO. Escape sequences](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=30.13) [provide an alternative means of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=33.82) [incorporating new lines and other control](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=35.15) [characters into literal strings. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=36.98) [backslashes used for escaping can be a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=39.92) [hindrance for Windows file system paths or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=41.92) [regular expressions, so raw strings with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=44.03) [the R prefix can be used to suppress the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=46.58) [escaping mechanism. Other types, such as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=48.68) [integers, can be converted to strings](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=51.7) [using the str constructor. Individual](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=53.38) [characters returned as one character](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=56.82) [strings can be retrieved using square](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=58.67) [brackets with integer zero‑based indices.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=60.65) [Strings support a rich variety of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=64.21) [operations, such a splitting, through](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=65.95) [their methods. In Python 3, literal](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=67.75) [strings can contain Unicode characters](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=71.12) [directly in the source. The bytes type has](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=72.96) [many of the capabilities of strings, but](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=76.55) [it is a sequence of bytes rather than a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=78.6) [sequence of Unicode code points. Bytes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=80.19) [literals are prefixed with a lowercase b.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=83.34) [To convert between string and bytes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=86.015) [instances, we use the encode method of str](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=88.91) [and the decode method of bytes. In both](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=90.334375) [cases, passing the encoding, which we must](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=92.86) [know in advance. Lists are mutable,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=95.06) [heterogeneous sequences of objects. List](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=98.1125) [literals are delimited by square brackets,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=101.81) [and the items are separated by commas. As](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=103.75) [with strings, individual elements can be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=106.91) [retrieved by indexing into a list with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=108.98) [square brackets. In contrast to strings,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=110.89) [Individual list elements can be replaced](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=114.4) [by assigning to the indexed item. Lists](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=116.35) [can be grown by appending to them, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=119.4) [they can be constructed from other](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=122.23) [sequences using the list constructor.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=123.4) [Dictionaries associate keys with values.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=126.16) [Literal dictionaries are delimited by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=129.81) [curly braces. The key value pairs are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=131.39) [separated from each other by commas, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=133.76) [each key is associated with its](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=135.86) [corresponding value with a colon. For](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=137.23) [loops take items one by one from an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=140.27) [iterable object, such as a list, and binds](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=142.48000000000002) [a name to the current item. They](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=144.46) [correspond to what are called for‑each](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=147.02) [loops in other languages. In the next](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=148.88) [module of Core Python: Getting Started,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=152.24) [we'll look at functions and modules,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=153.95) [Pythons fundamental tools for organizing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=156.02999999999997) [code. These tools will facilitate writing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=157.55) [larger programs and structure in your code into cohesive, reusable components.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=e870dd64-7aa9-488e-a637-d38536b5cf3a&clip=8&mode=live&start=160.15)

[Modularity](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live)

[Overview](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live)

[Modularity is an important property for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=1.2) [anything, but trivial software systems as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=3.05) [it gives us the power to make](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=5.11) [self‑contained, reusable pieces, which can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=6.2) [be combined in new ways to solve different](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=8.31) [problems. In this module of Core Python:](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=10.3) [Getting Started, we'll see that in Python,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=12.8) [as with most programming languages, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=15.47) [most fine‑grained modularization facility](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=17.37) [is the definition of reasonable functions,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=19.66) [we'll see how collections of related](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=21.869999999999997) [functions are typically grouped into](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=24.07) [source code files called modules, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=25.49) [we'll learn how modules can be used from](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=28.61) [other modules so long as we take care not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=30.17) [to introduce circular dependencies. We'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=32.26) [learn more about a topic we've already](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=35.08) [seen, importing modules into the REPL.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=36.63) [We'll show you how modules can be executed](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=39.69) [directly as programs or scripts. Along the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=41.39) [way, we'll investigate the Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=44.17) [execution model to assure you have a good](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=45.66) [understanding of exactly when code is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=47.51) [evaluated and executed. We'll round off by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=49.36) [showing you how to use command‑line](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=52.2) [arguments to get basic configuration data](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=53.55) [into your program and make your program](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=55.5) [executable. To illustrate this module,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=57.13) [we'll be taking the code snippet for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=59.99) [retrieving words from a web hosted text](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=61.39) [document that we developed at the end of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=63.21) [the previous module and organizing it into a fully‑fledged Python module.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=0&mode=live&start=64.65)

[Modules](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live)

[Let's start with the snippet we worked](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=1.1) [with last time. Open a text editor,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=2.54) [preferably one with syntax highlighting](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=5.01) [support for Python and configure it to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=6.59) [insert four spaces per indent level when](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=8.51) [you press the Tab key. You should also](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=10.54) [check that your editor saves the file](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=12.58) [using the UTF‑8 encoding, as that's what](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=14.18) [the Python 3 runtime expects by default.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=16.53) [Let's get the snippet we wrote at the REPL](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=19.24) [at the end of the previous module into a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=20.89) [text file called words.py. All Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=22.62) [source files used the .py extension. Now](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=25.62) [that we're using a text file for our code,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=28.48) [we can pay a little more attention to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=30.18) [readability. Let's put a blank line after](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=31.55) [the import statement. Save the file in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=33.69) [directory called corepy in your home](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=36.31) [directory. Switch to a console with your](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=38.22) [operating system's shell prompt and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=41.75) [changed the new corepy directory. We can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=43.47) [execute our module simply by calling](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=46.72) [python and passing the module's file name.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=48.39) [Use python3 words.py on Mac or Linux, or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=50.6) [python words.py on Windows. When you press](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=54.68) [Return, after a short delay, you'll be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=57.95) [returned to the system prompt, not very](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=59.78) [impressive, but if you got no response,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=62.11) [then the program is running as expected.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=64.17) [If, on the other hand, you got an error,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=66.08) [an HTTP error indicates there is a network](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=67.93) [problem, whilst other types of errors](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=70.32) [probably mean you have mistyped the code.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=72) [Let's add another for loop to the end of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=74.58) [the program to print out one word per](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=76.99) [line. If you run your module again, it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=78.79) [will print out the downloaded words. This](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=82.65) [is much better. Now we have the beginnings](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=84.62) [of a useful program. Our module can also](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=86.71) [be imported into the REPL. Let's try that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=89.16) [and see what happens. Start the REPL and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=91.31) [import your module by typing import words.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=93.27) [Note how when importing, we omit the file](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=96.24) [extension. The code in your module is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=98.25) [executed immediately when imported, maybe](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=100.43) [not what you expected and not very useful.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=102.78) [To give us more control over when our code](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=105.34) [is executed and to allow it to be reused, we'll need to put our code in a function.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=1&mode=live&start=107.12)

[Functions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live)

[Let's quickly define a new function at the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=1.08) [REPL to get the idea. Functions are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=2.83) [defined using the def keyword followed by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=5.08) [the function name, an argument list in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=7.26) [parenthesis, and a colon to start a new](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=8.9) [block. The code inside the function block](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=10.85) [must be indented. We use the return](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=13.22) [keyword to return a value from the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=15.6) [function, here returning an expression](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=17.13) [which evaluates to X squared. As we've](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=19.28) [seen previously, we call functions by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=23.16) [providing the actual arguments in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=25.05) [parentheses after the function name.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=26.49) [Functions aren't required to explicitly](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=28.74) [return a value though, perhaps they](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=30.44) [produce side effects, such as this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=32.36) [launch\_missiles function. Here, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=34.19) [message we see printed is a side effect of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=36.47) [calling print, not a return value from the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=38.27) [function. Generally speaking, it's good](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=40.38) [practice to prefer functions which return](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=42.72) [values rather than cause effects,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=44.48) [especially when the effects are as drastic](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=46.3) [as this. You can return early from a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=47.92) [function by using the return keyword with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=51.12) [no parameter. Both the return statement](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=53.07) [without a parameter, as well as the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=55.1) [implicit return at the end of a function](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=56.6) [actually causes the function to return](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=58.3) [none. Remember, however, that the REPL](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=60.16) [doesn't display none results, so we don't](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=63.075) [see them. By capturing the returned object](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=64.89) [into a named variable, we can test for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=67.37) [none. To reinforce these important ideas,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=69.12) [let's look at another example. Here's the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=71.795) [function nth\_root, which can be used to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=74.36) [compute the square root, cube roots,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=76.01) [fourth roots, and so on of a number we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=77.89) [supply, called the radicand. Internally,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=79.66) [it uses the nth fix raised to the power,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=82.87) [or exponentiation operator, which in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=84.88) [Python is the double star. Let's use](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=86.89) [nth\_root to compute the square root of 16,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=89.42500000000001) [giving 4, and again, to compute the cube](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=91.76) [root of 27, which is 3. See how the calls](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=94.17) [to the function evaluate to the value of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=97.32) [the returned expression. Our nth\_root](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=99.08) [function has only one point of return. Now](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=102.34) [consider our ordinal\_suffix function.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=105.07) [Ordinals are numbers like 1st, 2nd, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=107.44) [3rd, as opposed to cardinal numbers like](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=109.68) [1, 2, and 3. The ordinal\_suffix function](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=111.8) [is used to determine the suffixes ST, ND,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=115.14) [RD, and so on, which are used for ordinal](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=117.43) [numbers in English. The function uses an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=121.09) [if/elif structure to check the trailing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=124.605) [digits of the string representation of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=126.65) [value it has passed and contains seven](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=128.34) [points of return. Now comes the ordinal](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=130.29) [function. This takes a value and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=133.01) [concatenates its string representation](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=135.79500000000002) [with its ordinal\_suffix. It's common and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=136.945) [good practice to compose more complex](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=139.68) [functions out of more fundamental](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=141.44) [functions in this way. Function](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=142.78) [composition is the crucial technique for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=144.94) [controlling complexity in programs.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=146.82) [Lastly, we have the display\_nth\_root](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=149.91) [function. Given some radicand and n, it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=152.25) [delegates to our nth\_root function to do](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=154.65) [the mathematics, then performs the effect](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=156.38) [of printing a message, like the 2nd root](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=158.44) [of 16 is 4, delegating to ordinal and then](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=160.4) [onto ordinal\_suffix as necessary. This](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=163.29) [function has no explicit return statement](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=166.82) [at the end, so we can consider it to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=168.6) [finish with an implicit return none. Let's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=170.18) [try it at the REPL using it to display and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=173.65) [compute the 4th \root of 64. Before we go](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=175.9) [on, we need to take a quick aside](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=180.32) [regarding terminology. In Python, many](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=181.89) [language features are implemented or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=184.39) [controlled using specially named objects](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=186.35) [and functions. These special names](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=187.84) [generally have two leading and two](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=190.05) [trailing underscores. This has the benefit](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=191.65) [of making them visually distinct, fairly](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=194.25) [easy to remember, and unlikely to collide](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=196.23) [with other names. This scheme has the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=198.24) [disadvantage, however, of making these](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=200.23) [names difficult to pronounce, a problem we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=201.95) [face when making courses like this. To](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=204.06) [resolve this issue, we have chosen to use](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=207.96) [the term dunder when pronouncing these](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=209.7) [names. Dunder is a portmanteau of the term](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=211.45) [double underscore, and we'll use it to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=214.13) [refer to any name with leading and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=216.08) [trailing double underscores. So, for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=217.78) [example, when we talk about underscore](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=220.33) [underscore name underscore underscore,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=222.02) [something you'll soon encounter, we'll say](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=224.01) [dunder name. These kinds of names play a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=225.93) [big role in Python, so we'll be using this convention frequently.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=2&mode=live&start=228.45)

[\_\_name\_\_](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live)

[With some background on functions in place](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=1.24) [and the terminal logical exactitude](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=3.07) [established, let's get back to organizing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=5.14) [the code in our words module into](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=6.4) [function. We'll move all the code except](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=8.04) [the import statement, into a function](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=10.44) [called fetch words. You do that simply by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=12.01) [adding the def statement and indenting the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=14.85) [code below it by one extra level. Save the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=16.63) [module, start a fresh Python REPL, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=19.5) [import your module again with import](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=21.62) [words. The module imports, but now the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=23.76) [words are not fetched until we call the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=27.69) [fetch\_words function with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=29.27) [words.fetch\_words. This use of the dot is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=30.47) [called qualifying the function name with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=33.9) [the module name. Alternatively, we can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=36.03) [import are specific function using a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=38.925000000000004) [different form of the import statement,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=40.44) [from words import fetch\_words. Having](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=42.120000000000005) [imported the fetch\_words function directly](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=45.16) [into our REPL session, which is itself a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=46.89) [module, we can invoke fetch\_words using](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=48.75) [its unqualified name. So far, so good. But](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=51.15) [what happens when we try to run our module](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=54.68) [directly from the operating system shell?](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=56.34) [Exit from the REPL with Ctrl+D from Mac or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=58.39) [Linux, or Ctrl+Z for Windows, and run](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=61.07) [Python, passing the module file name. No](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=64.11) [words are printed, that's because all the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=66.02) [module does now is define a function and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=67.88) [then exit. The function is never called.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=69.88) [What we'd prefer is that the module](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=72.54) [actually print something when we execute](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=74.16) [it. To make a module from which we can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=75.94999999999999) [usefully import functions into the REPL](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=77.65) [and which can be run as a script, we need](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=79.52000000000001) [to learn a new Python idiom. As we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=81.68) [mentioned earlier, one of the specially](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=84.095) [named variables is called dunder name, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=85.77) [it gives us the means to detect whether](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=88.4) [our module has been run as a script or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=89.92) [imported into another module or the REPL.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=92.02) [To see how, add print dunder name at the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=94.09) [end of your module, outside of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=97.14) [fetch\_words function. Let's import the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=98.64) [modified words module back into the REPL](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=101.28) [with import words. We can see that when](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=103.28999999999999) [imported, dunder name does indeed evaluate](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=106.31) [to the module's name. As a brief aside, if](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=108.71) [you import the module again in the same](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=111.97) [REPL, the print statement will not be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=113.7) [executed. Module code is only executed](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=115.56) [once on first import. Now let's try](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=118.03) [running the module as a script from the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=121.15) [operating system shell with Python 3](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=122.78) [words.py. Now the special dunder name](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=125.0575) [variable is equal to the string dunder](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=128.61) [main, which is also delimited by double](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=130.41) [underscores. That is, Python sets the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=133.15) [value of dunder name differently,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=135.23) [depending on how our module is being used.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=136.86) [The key idea we're introducing here is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=139.19) [that our module can use this behavior to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=140.91) [decide how it should behave. We replaced](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=142.67) [the print statement with an if statement,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=145.42) [which tests the value of dunder name. If](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=147.01) [dunder name is equal to the string dunder](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=149.24) [main, we execute our function. On the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=150.48000000000002) [other hand, if dunder name is not equal to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=153.41) [dunder main, the module knows it's being](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=155.4) [imported into another module, not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=157.34) [executed, and so only defines the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=159.09) [fetch\_words function without executing it.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=161.25) [We can now safely import our module](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=164.14) [without unduly executing our function, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=165.89) [we can usefully run our module as a script.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=3&mode=live&start=168.74)

[The Python Execution Model](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live)

[It's important to understand the Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=1.04) [execution model and precisely when](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=2.72) [function definitions and other important](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=4.52) [events occur when a module is imported or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=6.35) [executed. Here, we show execution of our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=8.29) [Python module as it's imported in a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=11.64) [graphical debugging environment. We step](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=13.26) [through the top‑level statements in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=15.58) [module. What's important to realize here](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=16.86) [is that the def used for the fetch\_words](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=19.57) [function isn't merely a declaration. It's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=21.28) [actually a statement, which when executed](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=23.92) [in sequence with the other top‑level model](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=25.98) [scope code, causes the code within the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=27.89) [function to be bound to the name of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=29.84) [function. When modules are imported or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=31.54) [run, all of the top‑level statements are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=33.84) [run, and this is the means by which the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=35.99) [function within the module namespace are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=37.81) [defined. We are sometimes asked about the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=39.59) [difference between Python modules, Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=43.69) [scripts, and Python programs. Any .py file](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=45.59) [constitutes a Python module. But as we've](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=48.94) [seen, modules can be written for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=50.98) [convenient import, convenient execution,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=52.53) [or using the if dunder name = dunder main](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=54.87) [idiom, both. We strongly recommend making](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=57.75) [even simple scripts importable since it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=61.72) [eases development and testing so much if](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=63.62) [you can access your code from within the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=65.49) [REPL. Likewise, even modules, which are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=66.895) [only ever meant to be imported in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=69.6) [production settings, benefit from having](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=71.04) [executable test code. For this reason,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=72.85) [nearly all modules we create have this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=75.63) [form of defining one or more importable](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=77.48) [functions with a postscript to facilitate](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=79.34) [execution. Whether you consider a module](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=81.51) [to be a Python script or Python program is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=84.18) [a matter of context and usage. It's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=86.43) [certainly wrong to consider Python to be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=88.49) [merely a scripting tool, in the vein of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=90.09) [Windows batch files or UNIX Shell scripts,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=91.89) [as many large and complex applications are built exclusively with python.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=4&mode=live&start=94.34)

[Command Line Arguments](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live)

[Let's refine our word fetching module a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=1.04) [little further. First, we'll perform a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=2.99) [small refactoring and separate the word](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=5.15) [retrieval in collection on the one hand](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=7) [from the printing of words on the other.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=8.84) [This is because when importing, we'd](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=10.84) [rather get the words as a list. But when](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=12.31) [running directly, we prefer the words to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=14.07) [be printed. Here we move the printing code](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=15.69) [into a new function called print\_words.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=18.255000000000003) [We'll also modify our main block to first](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=22.44) [call fetch\_words and then call print\_words](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=24.75) [with the list of words returned by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=26.53) [fetch\_words. Next, we'll extract the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=27.915) [contents of our main block into a function](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=31.04) [called main. By moving this code into a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=32.82) [function, we contest it from the REPL,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=35.71) [something which isn't possible while it's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=37.43) [in the module scope if block. We can now](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=39.15) [try these functions from the REPL. We'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=43.28) [use this opportunity to introduce a couple](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=44.9725) [of new forms of the import statement. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=47.16) [first new form imports multiple objects](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=49.42) [from a module using a comma separated](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=51.48) [list. The parentheses are optional, but](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=53.28) [they do allow you to break this list over](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=55.88) [multiple lines if it gets too long. This](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=57.48) [form is perhaps the most widely used form](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=60.25) [of the import statement. The second new](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=62.09) [form imports everything from a module](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=64.63) [using an asterisk wild card. This latter](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=66.42) [form is recommended only for casual use at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=69.5) [the REPL. It can wreak havoc in programs,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=71.77) [since what is imported is now potentially](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=73.84) [beyond your control, opening yourself up](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=75.84) [to potential names space clashes at some](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=78.13) [future time. Having done this, we can get](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=79.81) [the words from the URL by calling](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=82.38) [fetch\_words. We can also print any list of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=83.87) [words by calling print\_words. And indeed,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=86.79) [we can run the main program. Notice that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=89.24) [the print\_words function isn't fussy about](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=92.27) [the types of the items in the list. It's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=94.21) [perfectly happy to print a list of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=95.98) [numbers. So perhaps print\_words isn't the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=97.38) [best name. In fact, the function doesn't](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=99.71) [mention lists either. It will happily](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=102.07) [print any collection that the for loop is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=104.18) [capable of iterating over, such as a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=105.86) [string. So let's perform another minor](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=107.5) [refactoring and rename this function to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=111.23) [print\_items, changing the variable names](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=112.94) [within the function to suit. We'll talk](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=114.83) [more about dynamic typing in Python, which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=116.51) [allows this degree of flexibility, in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=118.33) [next module. Another obvious improvement](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=120.09) [to our module would be to replace the hard](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=122.24) [coded URL with the value we can pass in.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=124) [Let's extract that value into an argument](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=126.57) [of the fetch\_words function. Now, when](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=128.42) [running our module is a standalone](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=130.6) [program, we'll need to accept the URL as a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=132.01) [command line argument. Access to command](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=134.09) [line arguments in Python is through the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=136.6) [attribute of the sys module called argv,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=138.09) [which is a list of strings. To use it, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=140.35) [must first import the sys module at the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=143.2) [top of our program. Then we need to get](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=144.87) [the second argument with an index of one](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=147.79) [from the list. Now, when we run the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=149.79) [program, it works as expected. This looks](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=152.91) [fine until we realize that we can't](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=156.06) [usefully test main any longer from the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=157.79) [REPL because it refers to sys.argv sub 1,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=159.53) [which is unlikely to have any useful value](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=160.87375) [in that environment. The solution is to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=164.46) [allow the argument list to be passed as a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=167.55) [formal argument to the main function,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=169.29) [using sys.argv as the actual parameter in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=171.05) [the if dunder name equals dunder main](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=173.59) [block. Testing from the REPL again, we can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=175.75) [now pass any URL we want into main. For](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=179.38750000000002) [more sophisticated command line](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=181.96) [processing, we recommend you look at the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=183.33) [Python standard library arg parse module](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=184.92) [or the inspired third‑party doc opt module.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=5&mode=live&start=187.29)

[Moment of Zen](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=6&mode=live)

[You'll notice that our top level functions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=6&mode=live&start=2) [have two blank lines between them. This is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=6&mode=live&start=3.94) [conventional for modern Python code. Two](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=6&mode=live&start=6.39) [between functions, that is the number of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=6&mode=live&start=9.52) [lines PEP8 recommends. According to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=6&mode=live&start=11.8) [PEP8 style guide, it's customary to use](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=6&mode=live&start=15.76) [two blank lines between module level](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=6&mode=live&start=18.01) [functions. We find this convention has](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=6&mode=live&start=19.88) [served us well, making code easier to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=6&mode=live&start=22.43) [navigate. We use single blank lines for logical breaks within functions.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=6&mode=live&start=24.31)

[Docstrings](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live)

[We saw previously how it was possible to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=1.48) [ask at the REPL for help on Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=3.52) [functions. Let's look at how to add this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=5.28) [self‑documenting capability to our own](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=7.54) [module. API documentation in Python uses a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=9.39) [facility called docstrings. Docstrings are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=13.4) [literal strings, which occur as the first](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=16.01) [statement within a named block, such as a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=17.84) [function or module. Let's document the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=19.79) [fetch\_words function. We use triple‑quoted](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=22.1) [strings, even for single‑line docstrings](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=25.84) [because they can be easily expanded to add](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=27.7) [more detail. One Python convention for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=29.79) [docstrings is documented in PEP 257,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=33.125) [although it is not widely adopted. Various](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=35.38) [tools, such as Sphinx, are available to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=37.89) [build HTML document from Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=39.77) [docstrings, and each tool mandates its](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=41.47) [preferred docstring format. Our preference](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=43.44) [is to use the form presented in Google's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=46.36) [Python Style Guide since it is amenable to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=48.14) [being machine parsed while still remaining](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=50.8) [readable at the console. Now we'll access](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=52.59) [this help from the REPL. We'll add similar](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=57.18) [docstrings to our other functions, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=61.59) [we'll add one for the module itself.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=64.67) [Module docstrings should be placed at the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=66.66) [beginning of the module before any](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=68.39) [statements. Now, when we request help on](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=69.87) [the module as a whole, we get quite a lot](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=74.41) [of useful information, including the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=76.23) [module docstring and each function docstring.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=7&mode=live&start=77.93)

[Comments](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=8&mode=live)

[We believe docstrings are the right place](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=8&mode=live&start=1.04) [for most documentation in Python code.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=8&mode=live&start=2.79) [They explain how to consume the facilities](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=8&mode=live&start=4.915) [your model provides rather than how it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=8&mode=live&start=7.17) [works. Ideally, your code should be clean](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=8&mode=live&start=8.76) [enough that ancillary explanation is not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=8&mode=live&start=11.24) [required. Nevertheless, it's sometimes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=8&mode=live&start=13.13) [necessary to explain why a particular](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=8&mode=live&start=15.66) [approach has been chosen or a particular](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=8&mode=live&start=17.58) [technique used, and we could do that using](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=8&mode=live&start=19.42) [Python comments. Comments in Python begin](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=8&mode=live&start=21.62) [with a hash, and they continue to the end](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=8&mode=live&start=24.31) [of the line. Let's document the fact that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=8&mode=live&start=25.99) [it might not be immediately obvious why](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=8&mode=live&start=29.26) [we're using sys.argv sub 1 rather than sys.argv sub 0.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=8&mode=live&start=31.05)

[Shebang](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live)

[It's common on UNIX‑like systems that have](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=1.04) [the first line of a script include a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=2.9) [special comment rather wonderfully called](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=4.29) [a shebang. This begins with the usual](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=6.13) [hash, as for any other comment, followed](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=8.76) [by an exclamation mark, shhh bang! This](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=10.86) [allows the program loader to identify](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=15.45) [which interpreter should be used to run](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=17.25) [the program. Shebangs have an additional](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=18.73) [purpose of conveniently documenting at the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=20.91) [top of a file whether the Python code](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=22.75) [therein is Python 2 or Python 3. The exact](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=24.83) [details of your shebang command depend on](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=27.94) [the location of Python on your system.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=29.99) [Typical Python 3 shebangs used the UNIX](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=32.94) [env program to locate Python 3 on your](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=35.004999999999995) [path environment variable, which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=37.72) [importantly, is compatible with Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=39.56) [virtual environments. On Mac or Linux, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=41.3) [must mark our script is executable using](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=44.78) [the command chmod +x words.py before the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=46.68) [shebang will have any effect. Having done](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=50.38) [that, we can now run our script directly.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=52.8) [Since Python 3.3, Python on Windows also](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=56.84) [supports the use of the shebang to make](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=59.73) [Python scripts directly excusable with the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=61.46) [correct version of the Python interpreter,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=63.49) [even to the extent that shebangs that look](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=65.53) [like they should only work on a UNIX‑like](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=67.38) [system will work as expected on Windows.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=69.06) [This works because Windows Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=71.87) [distributions now use a program called](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=73.34) [ylauncher. Pylauncher, the executable for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=75.31) [which is called simply py.exe, will parse](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=77.82) [the shebang and locate the appropriate](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=80.79) [version of Python. For example, on Windows](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=82.41) [in CMD, words.py followed by a URL will be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=85.13) [sufficient to run your script with Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=88.65) [3, even if you also have Python 2](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=90.32) [installed. In PowerShell, the equivalent](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=92.47) [is almost the same, .\words.py followed by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=94.95) [the URL. You can read more about pylauncher in PEP 397.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=9&mode=live&start=98.92)

[Summary](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live)

[Let's review what we've covered in this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=1.12) [module. We learned that Python code is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=2.54) [generally placed in .py files called](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=5.14) [modules. We saw how modules can be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=7.57) [executed directly by passing them as the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=10.39) [first argument to the Python interpreter,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=12.26) [and that modules can also be imported into](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=14.125) [the REPL, at which point all top‑level](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=16.42) [statements in the module are executed in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=18.59) [order. We looked at how named functions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=20.42) [are defined using the def keyword followed](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=23.13) [by the function name and the argument list](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=25.38) [in parentheses, and how we can return](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=27.15) [objects from functions using the return](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=29.03) [statement. Related to this, we learned](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=30.7) [that return statements without a parameter](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=33.9) [return None, as does the implicit return](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=35.62) [at the end of every function body. We saw](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=37.985) [how we can detect whether a module has](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=41.09) [been imported or executed by examining the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=42.6) [value of the special \_\_name\_\_ variable. If](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=44.56) [it is equal to the string \_\_main\_\_, then](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=47.44) [are module has been executed directly as a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=49.56) [program. We learned how to use this to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=51.29) [write the if \_\_name\_\_ == '\_\_main\_\_' check.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=54.24) [By calling a function when this check](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=56.93) [succeeds, we can make our module both](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=58.65) [usefully importable and executable, an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=60.67) [important testing technique even for short](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=62.94) [scripts. We saw that module code is only](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=64.85) [executed once, on first import. We learned](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=67.99) [that the def keyword is a statement which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=71.38) [binds executable code to a function name.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=73.39) [We investigated how command line arguments](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=76.58) [can be accessed as a list of strings](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=78.49) [accessible through the argv attribute of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=80.24) [the sys module. The zeroth command line](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=82.2) [argument is the script file name, so the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=85.17) [item at index 1 is the first true](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=87.33) [argument. We saw that Python's dynamic](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=89.35) [typing means our functions can be very](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=92.37) [generic with respect to the type of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=94.15) [arguments. We looked into using literal](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=95.56) [strings as the first line of a function](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=98.46) [definition to form the function's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=100.16) [docstring. They're typically triple quoted](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=101.785) [multi‑line strings containing usage](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=103.98) [information. We learned that function](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=105.59) [documentation provided in docstrings can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=108.3) [be retrieved using help in the REPL.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=110.21) [Similar to function docstrings, we saw](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=112.61500000000001) [that module docstrings should be placed](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=115.03) [near the beginning of the module prior to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=116.71) [any Python statements such as import](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=118.25) [statements. We covered how comments in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=120.02) [Python commence with the hash character](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=122.74) [and continue to the end of the line.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=124.4) [Finally, we looked at how the first line](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=127.04) [of the module can contain a special](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=129.05) [comment called a shebang, allowing the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=130.54) [program loader to launch the correct](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=132.52) [Python interpreter on all major platforms.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=134.13) [In the next module of Core Python: Getting](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=137.1) [Started, we'll dig into Python's object](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=140.17) [model, looking at how values are passed to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=142.03) [and returned from functions. We'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=144.15) [investigate the nature of dynamic typing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=146.32) [in Python, and focus on rules for variable](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=147.95499999999998) [scope. Thanks for watching, and we'll see you in the next module.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=185714ae-875d-40d0-89ac-627f9a13151c&clip=10&mode=live&start=150.24)

[Objects and Types](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live)

[Overview](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live)

[While you can get a long way in Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=1.04) [with fairly shallow understanding of its](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=2.73) [underlying model, we find that even just a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=4.48) [small understanding of its deeper](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=6.7) [structure can yield deep insight, making](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=8.19) [you more productive and helping you design](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=10.26) [better programs. In this module of Core](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=11.95) [Python: Getting Started, we'll seek to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=14.3) [understand the Python object model. We'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=16.1) [see that the notion of named references to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=19.09) [objects is key to how Python works. We'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=21.2) [discuss the important difference between](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=24.56) [value equality and identity equality.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=26.6) [We'll see how argument passing and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=29.54) [returning from functions in Python fits](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=31.06) [into the object model. We'll investigate](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=32.7) [Python's type system. We'll look at how](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=35.52) [Python uses scopes to limit access to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=38.1) [names in a program. And we'll introduce](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=40.18) [you to a core insight for understanding](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=42.9) [Python programs, the idea that everything](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=44.53) [is an object. The topics in this module](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=46.72) [may seem abstract or even simplistic, but](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=49.56) [if you internalize these concepts, you'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=51.7) [find that you're able to reason about](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=53.42) [Python much more fluidly and with greater](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=54.73) [precision. We've already talked about and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=56.55) [used variables in Python, but what exactly](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=60.43) [is a variable? What's going on when we do](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=62.3) [something as straightforward as assigning](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=64.49) [an integer to a variable? In this case,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=66.08) [Python creates an int object with a value](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=68.62) [of 1000, an object reference with the name](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=70.51) [x, and arranges for x to refer to the into](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=72.72999999999999) [1000 object. If we now modify the value of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=75.46) [x with another assignment, what does not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=78.975) [happen is a change in the value of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=80.9) [integer object. Integer objects in Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=82.52) [are immutable and cannot be changed. In](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=84.94) [fact, what happens is that Python creates](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=87.61) [a new immutable integer object with the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=89.36) [value 500 and redirects the x reference to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=91.11) [point to the new object. We now have no](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=93.73) [way of reaching the int 1000 object, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=96.76) [the Python garbage collector will reclaim](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=98.8) [it at some point. When we assign from one](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=100.57) [variable to another, we're really](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=103.71) [assigning from one object reference to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=105.22) [another object reference, so both](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=106.88) [references now refer to the same object.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=108.46) [If we now reassign x, we have x referring](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=111.34) [to an int 3000 object and y referring to a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=113.91) [separate int 500. There is no work for the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=116.82) [garbage collector to do, because all](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=119.38) [objects are reachable from live](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=120.98) [references. Let's dig a little deeper](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=122.23) [using the built‑in id function. Id returns](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=125.98) [an integer identifier that is unique and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=128.66) [constant for the lifetime of an object.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=130.57) [Let's rerun the previous experiment using](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=133.31) [id. First we'll assign a to the integer](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=135.23) [496 and check its id. Then we'll assign b](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=138.05) [to 1729, and see that it has a different](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=141.98) [id. If we now make b refer to the same](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=145.23) [object as a, we'll see that they have the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=148.56) [same id. Note that the id function is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=150.31) [seldom used in production Python code. Its](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=153.52) [main use is in object model tutorials such](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=155.85) [as this one, and as a debugging tool. Much](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=158.1) [more commonly used than the id function is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=161.13) [the is operator, which tests for equality](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=163.02) [of identity. That is, it tests whether two](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=165.37) [references refer to the same object. We've](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=168.51) [already met the is operator earlier in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=171.04) [course when we tested for None. Even](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=172.97) [operations which seem naturally mutating](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=175.85) [in nature are not necessarily so. Consider](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=177.77) [the augmented assignment operator. If we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=180.26) [create an integer and then increment it by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=182.98) [2, we see that the id of the incremented](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=184.69) [integer is different from the original.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=187.25) [Now let's look at that pictorially. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=190.45) [start with t referring to an int 5 object.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=192.49) [Augmented assignment creates an int 2](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=195.38625) [without assigning a reference to it. It](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=197.53) [then adds the int 2 with the int 5 to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=199.97) [create a new int 7. Finally, it assigns t](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=201.8775) [to the int 7, and the remaining ints are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=205.72) [garbage collected. Python objects show](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=207.57) [this behavior for all types. A core rule](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=210.33) [to remember is this, the assignment](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=212.91) [operator only ever binds objects to names.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=214.82) [It never copies an object to a value.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=217.33) [Let's look at another example using](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=220.92) [mutable objects, lists. We create a list](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=222.44) [object with three elements, binding the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=225.87) [list object to a reference named r. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=227.57) [then assign r to a new reference s. When](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=230.58) [we modify the list referred to by s, by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=233.95) [changing the middle element, we see that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=236.07) [the r list has changed as well. This](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=237.95) [happens since the names s and r, in fact](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=240.86) [refer to the same object, which we can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=243.21) [verify with the is operator. Let's see](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=244.84) [that again with a diagram. First we assign](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=248.12) [r to a new list. Then we assign s to r,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=250.42) [creating a new name for the existing list.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=253.15) [If we modify s, we also modify r, because](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=255.74) [we're modifying the same underlying](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=258.4) [object. S is r is true, because both names](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=259.92) [refer to the same object. If you want to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=263.4) [create an actual copy of an object such as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=266.25) [a list, other techniques must be used,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=268.21) [which we'll look at later. It turns out](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=270.05) [that Python doesn't really have variables](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=273.11) [in the metaphorical sense of a box holding](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=274.74) [a value. It only has named references to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=276.48) [objects, and the references behave more](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=279.23) [like labels, which allow us to retrieve](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=281.04) [objects. That said, it's still common to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=282.73) [talk about variables in Python. We will](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=285.14) [continue to do so, secure in the knowledge](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=287.21) [that you now understand what's really](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=289.26) [going on behind the scenes. Let's contrast](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=290.66) [the behavior of the is operator with the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=294.82) [test for value equality, or equivalence.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=296.71) [We'll create two identical lists. First,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=298.995) [we'll test them for equivalence with the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=302.38) [double equals operator. Then we'll test](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=303.91) [them for identity equality with is. Here](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=307.21) [we see that p and q refer to different](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=310.36) [objects, but that the objects they refer](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=312.22) [to have the same value. Of course, an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=313.92) [object should almost always be equivalent](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=316.77) [to itself. Here's how that looks](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=318.59) [pictorially. We have two separate list](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=321.43) [objects, each with a single reference to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=323.45) [it. The values contained in the lists are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=325.23) [the same, that is, they are equivalent or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=327.21) [value equal, even though they have](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=329.21) [different identities. Value equality and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=330.9) [identity are fundamentally different](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=334.11) [notions of equality, and it's important to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=335.67) [keep them separate in your mind. It's also](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=337.52) [worth noting that value comparison is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=339.86) [something that is defined](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=341.42) [programmatically. When you define types,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=342.35) [you can control how that class determines](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=344.53) [value equality. In contrast, identity](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=346.31) [comparison is defined by the language, and you can't change that behavior.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=0&mode=live&start=349.05)

[Passing Arguments and Returning Values](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live)

[Now let's look at how all this relates to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=1.04) [function arguments and return values.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=2.76) [Let's define a function at the REPL, which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=4.77) [appends a value to a list and prints the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=6.4) [modified list. First, we'll create a list.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=8.19) [Then we'll make a function, modify, which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=11.54) [appends to and prints the list. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=13.84) [function accepts a single formal argument](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=15.89) [named k. We then call modify, passing our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=17.64) [list m as the actual argument. This indeed](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=21.53) [prints the modified list with four](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=24.43) [elements. But what does our list reference](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=25.85) [outside the function now refer to? The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=27.76) [list referred to by m has been modified](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=30.43) [because it is the self same list referred](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=32.39) [to by k inside the function. When we pass](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=34.15) [an object reference to a function, we're](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=38.36) [essentially assigning from an actual](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=40.12) [argument reference, in this case m, to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=41.42) [formal argument reference, in this case k.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=43.75) [As we've seen, assignment causes the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=46.192499999999995) [reference being assigned to to refer to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=48.3) [the same object as the reference being](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=50.06) [assigned from. This is exactly what's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=51.47) [going on here. If you want the function to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=53.68) [modify a copy of an object, it's the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=56.63) [responsibility of the function to do the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=58.35) [copying. Let's look at another instructive](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=59.9) [example. First will define a new list,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=63.74) [then will define a function which replaces](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=67.44) [the list. Now we'll call replace with f as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=69.25) [the argument. It prints the new list,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=72.79499999999999) [which is much as we'd expect. However,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=75.39) [what's the value of f after the call? F](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=77.6) [still refers to the original unmodified](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=80.24) [list. This time, the function did not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=82.27) [modify the object that was passed in.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=84.47) [What's going on? Well, the object](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=86.25) [reference named f was assigned to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=89.62) [formal argument named g, so g and f did](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=91.31) [indeed refer to the same object, just as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=93.78) [in the previous example. However, on the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=95.86) [first line of the function, we reassigned](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=98.48) [the reference g to point to a newly](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=100.3) [constructed list 17, 28, 45. So within the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=101.86) [function, the reference to the original](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=106.03) [list 14, 23, 37, was overwritten, although](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=107.61) [the original list was still pointed to by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=111.2) [the f reference outside the function. So](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=112.96) [we've seen that it's quite possible to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=116.78) [modify the objects through function](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=118.29) [argument references, but also possible to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=119.69) [rebind the argument reference to new](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=121.78) [values. If you wanted to change the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=123.33) [contents of the list and have the changes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=125.95) [seen outside the function, you could](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=127.49) [modify the contents of the list by writing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=128.98) [a function that replaces each element of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=130.81) [this list in place. Now we define f and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=132.51) [pass it into replace\_contents. And indeed,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=135.96) [the contents of f have been modified by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=139.19) [the function. Function arguments are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=140.79) [transferred by what is called](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=144.18) [pass‑by‑object‑reference. This means that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=145.45) [the value of the reference is copied into](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=147.75) [the function argument, not the value of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=149.5) [the referred to object. No objects are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=151.26) [copied. The return statement uses the same](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=153.25) [pass‑by‑object‑reference semantics as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=157.51) [function arguments. We can demonstrate](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=159.27) [this by writing a simple function that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=161.2) [just returns it's only argument. Create an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=162.6) [object such as a list and pass it through](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=165.48) [this simple function. We see that it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=167.29) [returns the very same object we passed in,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=169.82) [showing that no copies of the list were made.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=1&mode=live&start=171.965)

[Function Arguments](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live)

[Now that we understand the distinction](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=1.04) [between object references and objects,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=2.48) [we'll look at some more capabilities of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=4.19) [function arguments. The formal function](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=5.61) [arguments specified when a function is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=8.24) [defined with the def keyword are a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=9.91) [comma‑separated list of the argument](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=11.88) [names. These arguments can be made](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=13.55) [optional by providing default values.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=15.38) [Consider a function which prints a simple](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=17.47) [banner to the console. This function takes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=19.02) [two arguments, the second of which is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=21.91) [provided with a default value, in this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=23.59) [case a hyphen, in a literal string. Since](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=25.35) [we've given it this default value, callers](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=28.68) [can choose whether they want to pass their](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=30.52) [own value for border or use the default.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=31.98) [Note that when we define functions using](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=36.14) [default arguments, the parameters with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=37.91) [default arguments must come after those](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=39.69) [without defaults. Otherwise, we will get a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=41.52) [syntax error. Within the body of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=43.25) [function. We multiply our border string by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=46) [the length of the message string. This](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=47.81) [shows how we can determine the number of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=50.14) [items in a Python collection using the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=51.53) [built‑in lend function. Secondly, it shows](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=53.05) [how multiplying a string, in this case the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=55.72) [single‑character string border, by an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=57.63) [integer results in a new string containing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=59.25) [the original string repeated a number of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=61.07) [times. We use that feature here to make a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=62.73) [string equal in length to our message. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=65.03) [then print the full width border, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=67.8) [message, and the border again. When we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=69.33) [call our banner function, we don't need to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=71.77) [supply the border string because we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=73.49) [provided a default value. We can see that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=75) [the default border of hyphens has been](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=78.36) [created. However, if we do provide an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=79.82) [optional argument, it's used. In](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=82.19) [production code, this function call is not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=84.16) [particularly self documenting. We can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=85.89) [improve that situation by naming the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=88.02) [border argument at the call site. In this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=89.59) [case, the message string is called a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=92.4) [positional argument and the border string](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=93.92) [a keyword argument. The actual positional](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=95.82) [arguments are matched up in sequence with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=98.31) [the formal arguments, that is by position,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=99.89) [whereas the keyword arguments are matched](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=102.31) [by name. If we use keyword arguments for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=103.92) [both of our parameters, we have the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=106.28) [freedom to supply them in any order.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=107.76) [Remember though that all keyword arguments](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=110.48) [must be specified after the positional](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=111.73) [arguments. It's crucial to have an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=113.55) [appreciation of exactly when the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=117.21) [expression provided as a default value is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=118.81) [evaluated. This will help you avoid a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=120.71) [common pitfall, which frequently ensnares](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=122.71) [newcomers to Python. Let's examine this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=124.59) [question closely using the Python standard](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=126.65) [library time module. We can easily get the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=128.54) [time as a readable string by using the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=131.95) [ctime function of the time module. Let's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=133.66) [write a function, which uses a value](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=136.53) [retrieved from ctime as a default argument](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=138.04) [value. So far, so good. But notice what](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=140.18) [happens when you call show\_default again a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=143.24) [few seconds later, and again. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=145.1) [displayed time never progresses. Recall](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=147.73) [how we said that def is a statement that,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=150.36) [when executed, binds a function definition](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=151.98) [to a function name? Well, the default](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=153.77) [argument expressions are evaluated only](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=155.85) [once when the def statement is executed.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=157.69) [Normally, when the default is a simple,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=160.09) [immutable constant, such as an integer or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=161.73) [a string, this causes no problems. But it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=163.48) [can be a confusing trap for the unwary](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=165.91) [that usually shows up in the form of using](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=167.63) [mutable collections as argument defaults.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=169.39) [Let's take a closer look. Consider this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=173.54) [function, which uses an empty list as a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=175.56) [default argument. It accepts a menu, which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=177.2) [will be a list of strings, appends the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=179.42) [item spam to the list, and returns the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=181.22) [modified menu. Let's create a simple](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=182.99) [breakfast of bacon and eggs. Naturally,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=185.78) [we'll want to add Spam to it. We'll, do](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=188.52) [something similar for our lunch of baked](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=191.14) [beans. Nothing unexpected so far. But look](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=192.71) [what happens when you rely on the default](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=196.14) [argument by not passing an existing menu.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=197.63) [When we append spam to the default value](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=200.54) [of the empty menu, we get just spam. Let's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=202.56) [do that again. When we exercise the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=205.2) [default argument value a second time, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=207.72) [get two spams, and three and four. What's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=209.49) [happening here is that the empty list used](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=213.77) [for the default argument is created](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=215.46) [exactly once, when the def statement is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=216.81) [executed. The first time we fall back on](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=218.74) [the default, this list has spam added to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=221.03) [it. When we use the default a second time,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=223.07) [the list still contains that item, and a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=225.53) [second instance of spam is added to it,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=227.53) [making two, ad infinitum, or perhaps ad](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=229.28) [nauseum would be more appropriate. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=232.4) [solution to this is straightforward, but](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=235.13) [perhaps not obvious. Always use immutable](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=236.75) [objects such as integers or strings for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=239.28) [default values. Following this advice, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=241.04) [can solve this particular case by using](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=244.48) [the immutable None object as a sentinel.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=246.17) [Now our function needs to check if menu is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=249.3) [none and provide a newly constructed empty](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=251.04) [list, if so. The rest of the function](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=252.86) [behaves as before. Now, if we call the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=255.14) [function repeatedly with no arguments, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=257.81) [get the same menu, one order of spam each time.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=2&mode=live&start=259.46)

[Python's Type System](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live)

[Programming languages can be distinguished](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=1.04) [by several characteristics, but one of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=2.62) [most important is the nature of their type](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=4.35) [system. Python could be characterized as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=6.06) [having a dynamic and strong type system.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=8.36) [Let's investigate what that means. Dynamic](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=10.84) [typing means the type of an object](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=14.18) [reference isn't resolved until the program](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=15.77) [is running, and needn't be specified up](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=17.55) [front when the program is written. Take a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=19.38) [look at this simple function for adding](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=21.36) [two objects. Nowhere in this definition do](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=22.76) [we mention any types. We can use add with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=25.54) [integers, floats, strings, or indeed any](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=27.96) [type for which the addition operator has](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=30.43) [been defined. These examples illustrate](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=31.94) [the dynamism of the type system. The two](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=35.23) [arguments, a and b, of the add function](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=37.3) [can reference any type of object. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=39.27) [strength of the type system can be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=41.97) [demonstrated by attempting to add types](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=43.31) [for which addition has not been defined,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=45) [such as strings and floats. This produces](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=46.74) [a type error, because python will not, in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=49.18) [general, perform implicit conversions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=51.03) [between object types, or otherwise attempt](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=52.74) [to coerce one type to another. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=54.55) [exception to this rule is the conversion](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=56.56) [of if statement and while loop predicates to bool.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=3&mode=live&start=58.16)

[Scopes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live)

[As we've seen, no type declarations are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=1.04) [necessary in Python, and variables are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=2.88) [essentially just untyped name bindings to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=5.25) [objects. As such, they can be rebound or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=6.82) [reassigned as often as necessary, even to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=9.43) [objects of different types. But when we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=11.85) [bind the name to an object, where is that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=13.95) [binding stored? To answer that question,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=15.63) [we must look at scopes and scoping rules](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=17.78) [in Python. There are four types of scope](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=19.384999999999998) [in Python arranged in the hierarchy. Each](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=22.7) [scope is a context in which names are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=24.9) [stored and in which they could be looked](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=26.45) [up. The four scopes, from narrowest to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=27.84) [broadest, are local, names defined inside](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=30.17) [the current function; enclosing, names](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=32.61) [defined inside any and all enclosing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=35.18) [functions, this scope isn't important for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=37.07) [the contents of this Python fundamentals](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=39.35) [course; global, names defined at the top](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=41.04) [level of a module, each module brings with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=44.17) [it a new global scope; built‑in, names](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=46.45) [built into the Python language through the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=49.61) [special built‑ins module. Together, these](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=51.04) [scopes comprise the LEGB rule. Names are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=54.15) [looked up in the narrowest relevant](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=56.94) [context. It's important to note that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=58.43) [scopes in Python do not correspond to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=60.99) [source code blocks as demarcated by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=62.82) [indentation. For loops and the like do not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=64.48) [introduce new nested scopes. Consider our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=66.95) [words.py module. It contains the following](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=70.53) [global names, main bound by deaf main, sys](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=73.14) [bound by import sys, dunder name provided](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=77.07) [by the Python runtime, urlopen bound by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=80.26) [from urllib.request import urlopen,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=83.73) [fetch\_words bound by def fetch\_words,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=86.69999999999999) [print\_items bound by def print\_items.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=89.715) [Module scope name bindings are typically](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=92.81) [introduced by import statements and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=95.25) [function or class definitions. It's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=96.8) [possible to use other objects at module](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=98.78) [scope, and this is typically used for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=100.55) [constants, although it can be used for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=101.92) [variables. Within the fetch\_words](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=103.4) [function, we have six local names, word](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=106.42) [bound by the inner for loop, line\_words](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=108.84) [bound by assignment, line bound by the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=111.27) [outer for loop, story\_words bound by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=113.83) [assignment, url bound by the formal](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=116.08) [function argument, and story bound by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=119) [assignment. Each of these is brought into](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=120.87) [existence at first use and continues to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=124.07) [live within the function scope until the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=126.03) [function complete, at which point, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=127.55) [references will be destroyed. Very](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=129.13) [occasionally, we need to rebind a global](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=132.66) [name, that is, one defined at module](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=134.58) [scope, from within a function. Consider](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=136.47) [the following simple module, it initialize](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=138.76) [is count to 0 at module scope. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=141.04) [show\_count function simply prints the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=144.41) [value of count, and set\_count binds the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=146.01) [name count to a new value. When show\_count](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=148.6) [is called, Python looks up the count name](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=151.76) [in the local namespace, doesn't find it,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=153.66) [so it looks it up in the next most outer](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=155.805) [namespace, in this case, the global module](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=157.31) [namespace, where it finds the name\_count](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=159.38) [and prints the referred to object. Now we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=161.41) [call set\_count with a new value and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=164.27) [show\_count again. You might be surprised](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=166.21) [that show\_count displays 0 after the call](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=169.18) [to set\_count 5, so let's work through](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=171.13) [what's happening. When we call set\_count,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=173.01) [the assignment, count = c, binds the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=175.9) [object referred to by the formal argument,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=178.23) [c, to a new name, count, in the innermost](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=180.08) [namespace context, which is the scope of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=182.35) [the current function. No look‑up is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=184.23) [performed for the global\_count at module](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=186.34) [scope. We've created a new variable which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=188.65) [shadows and thereby prevents access to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=190.47) [global of the same name. To avoid this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=192.79) [situation, we need to instruct Python to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=195.6) [consider use of the count name in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=197.56) [set\_count function to resolve to the count](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=199.24) [in the module namespace. We can do this by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=201.14) [using the global keyword. Let's modify](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=203.44) [set\_count to do so. The additional call to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=205.69) [show\_count still behaves as expected.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=208.59) [Calling set\_count, however, does now](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=210.84) [modify the count preference at module scope. This is the behavior we want.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=4&mode=live&start=212.64)

[Moment of Zen](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=5&mode=live)

[Special cases aren't special enough to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=5&mode=live&start=2.01) [break the rules. We follow patterns, not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=5&mode=live&start=4.23) [to kill complexity, but to master it. As](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=5&mode=live&start=7.01) [we have shown, all variables in Python are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=5&mode=live&start=10.23) [references to objects, even basic types,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=5&mode=live&start=12.28) [such as integers. This thorough approach](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=5&mode=live&start=14.54) [to object orientation is a strong theme in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=5&mode=live&start=16.985) [Python, and practically everything in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=5&mode=live&start=19.32) [Python is an object, including functions and modules.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=5&mode=live&start=20.88)

[Everything is an Object](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live)

[Let's go back to our words module and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=1.04) [experiment with it further at the REPL. On](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=2.72) [this occasion, we'll import just the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=4.86) [module. The import statement binds a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=6.32) [module object to the name words in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=9.09) [current name space. We can determine the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=10.92) [type of any object by using the type built](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=12.96) [in function. If we want to see the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=15.23) [attributes of an object, we can use the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=17.6) [dir built in function in a Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=19.24) [interactive session to introspect it. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=20.92) [dir function returns assorted list of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=23.84) [module attributes, including the ones we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=25.63) [defined, such as the function fetch words,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=27.28) [any imported names, such as sys and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=29.55) [urlopen, and various special attributes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=31.59) [delimited by double underscores, such as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=34.05) [dunder name and dunder doc, which reveal](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=36.03) [the inner workings of Python. We can use](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=37.99) [the type function on any of these](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=40.17) [attributes to learn more about them. For](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=41.62) [instance, we could see that fetch words is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=43.74) [a function object. We can in turn call dir](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=45.22) [on the function to reveal its attributes.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=48.417500000000004) [We see that function objects have many](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=51.24) [special attributes to do with how Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=52.8) [functions are implemented behind the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=54.49) [scenes. For now, we'll just look at a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=55.86) [couple of simple attributes. As you might](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=57.74) [expect, words dot fetch\_words dot dunder](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=59.62) [name is the name of the function object as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=61.9) [a string. Likewise, words dot fetch\_words](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=63.67) [dot dunder doc is the doc string we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=67.53) [provided for the function. This gives us](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=69.17) [some clues as to how the built in help function might be implemented.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=6&mode=live&start=71.23)

[Summary](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live)

[We've covered a lot of important concepts](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=1.04) [about how the Python language works in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=2.71) [this module. Let's summarize what we've](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=4.19) [been over. It's better to think of Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=5.98) [working in terms of named references to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=8.32) [objects rather than variables and values.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=10.04) [Assignment doesn't put a value in a box.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=13.34) [It attach is a name tag to an object.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=15.33) [Assigning from one reference to another](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=18.14) [puts two name tags on the same object. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=19.7) [Python garbage collector will reclaim](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=22.68) [unreachable objects, those objects with no](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=24.46) [name tag. The id function returns a unique](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=26.4) [and constant identifier, but should](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=29.92) [rarely, if ever, be used in production.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=31.36) [The is operator determines equality of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=34.31) [identity, that is, whether two names refer](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=36.47) [to the same object. We can test for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=38.76) [equivalents using the == operator.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=41.38) [Function arguments are passed by object](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=44.85) [reference, so functions can modify their](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=46.2) [arguments if they are mutable objects. If](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=48.06) [a formal argument is rebound through](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=51) [assignment, the reference to the passed in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=52.52) [object is lost. To change a mutable](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=54.29) [argument, you should replace its contents](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=56.62) [rather than replacing the whole object.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=58.43) [The return statement also passes by object](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=61.02) [reference, no copies are made. Function](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=63.04) [arguments can be specified with defaults.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=65.76) [Default argument expressions are evaluated](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=68.64) [only once when the def statement is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=70.59) [executed. Python uses dynamic typing, so](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=72.17) [we don't need to specify reference types](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=75.5) [in advance. Python uses strong typing.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=77.16) [Types are not coerced to match. Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=80.3) [reference names are looked up in one of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=83.42) [four nested scopes according to the LEGB](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=84.92) [rule, local to functions, in enclosing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=87.41) [functions, and the global or module](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=89.79) [namespace, and built‑ins. Global](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=91.53) [references could be read from a local](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=94.46) [scope. Assigning to a global reference](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=95.9) [from a local scope requires that the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=98.56) [reference be declared global using the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=100.04) [global keyword. Everything in Python is an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=101.83) [object, including modules and functions.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=104.91) [They could be treated just like other](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=107.03) [objects. The import and def keywords](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=108.33) [result in binding to named references. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=111.36) [built‑in type function could be used to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=114.35) [determine the type of an object. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=115.97) [built‑in dir function can be used to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=118.49) [introspect an object and return a list of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=120.1) [its attribute names. The name of a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=122.01) [function or module object can be accessed](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=124.62) [through its dunder name attribute. The doc](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=126.5) [string for a function or module object can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=129.41) [be accessed through its dunder doc](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=131.14) [attribute. In passing, we also saw that we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=132.75) [can use len to measure the length of a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=135.71) [string. If we multiply a string by an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=137.3) [integer, we get a new string with multiple](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=140.06) [copies of the operand string. This is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=141.9) [called the repetition operation. In the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=143.84) [next module of Core Python: Getting](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=147.77) [Started, we'll revisit a few collections](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=149.28) [that we've already met for a deeper look.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=151.16) [We'll also introduce you to a few new](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=153.21) [ones, tuple, range, and set, as well as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=154.8) [the concept of protocols which unite the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=157.59) [various collection types. Thanks for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=159.46) [watching, and we'll see you in the next module.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=9f197c69-32c6-4e7b-9653-2e1a70143e24&clip=7&mode=live&start=161.46)

[Built-in Collections](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=0&mode=live)

[Overview](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=0&mode=live)

[Python comes with a powerful suite of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=0&mode=live&start=1.04) [built‑in collection types, several of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=0&mode=live&start=2.64) [which you've seen already in earlier](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=0&mode=live&start=4.31) [modules. To be truly fluent in Python, you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=0&mode=live&start=5.65) [need to be familiar with all of these](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=0&mode=live&start=7.98) [types and how to use them. So in this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=0&mode=live&start=9.37) [module, we'll take another deeper look at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=0&mode=live&start=11.13) [the collection types you already know,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=0&mode=live&start=13) [str, list, and dict. We'll introduce you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=0&mode=live&start=14.58) [to some new collection types. First, we'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=0&mode=live&start=17.79) [look at tuple, an immutable sequence of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=0&mode=live&start=19.95) [objects. Then, we'll cover range, which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=0&mode=live&start=21.6) [represents arithmetic progressions of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=0&mode=live&start=24.43) [integers. Finally, we'll see set,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=0&mode=live&start=25.97) [immutable collection of unique, immutable](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=0&mode=live&start=28.94) [objects. We'll round off with an overview](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=0&mode=live&start=30.9) [of the protocols that unite these](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=0&mode=live&start=33.79) [collections, which allow them to be used](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=0&mode=live&start=35.18) [in consistent and predictable ways. First up is tuple.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=0&mode=live&start=36.93)

[Tuples](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live)

[Tuples in Python are immutable sequences](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=1.04) [of arbitrary objects. Once created, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=3.17) [objects within them cannot be replaced or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=5.8) [removed, and new elements cannot be added.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=7.59) [Tuples have a similar syntax to lists,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=10.94) [except that they are delimited by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=13.03) [parentheses rather than square brackets.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=14.17) [Here's a literal tuple containing a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=16.74) [string, a float, and an integer. We can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=18.09) [access the elements of a tuple by 0‑based](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=21.1) [index using square brackets. We can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=23.05) [determine the number of elements in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=25.96) [tuple using the built‑in len function, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=27.28) [we can iterate over it using a for loop.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=30.24) [We can concatenate tuples using the plus](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=33.34) [operator and repeat using the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=35.18) [multiplication operator. Since tuples can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=36.78) [contain any object, it's perfectly](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=40.33) [possible to have nested tuples. We use](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=42.02) [repeated application of the indexing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=44.9) [operator to get to the inner elements of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=46.57) [such nested collections. Sometimes a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=48.16) [single element tuple is required. To write](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=51.56) [this, we can't just use a simple number in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=53.84) [parentheses. This is because Python parses](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=55.68) [that as an integer enclosed in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=58.17) [precedence controlling parentheses of a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=59.69) [math expression. To create a single](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=61.29) [element tuple, we make use of the trailing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=64.04) [comma separator, which you'll recall,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=65.95) [we're allowed to use when specifying](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=67.97) [literal tuples, lists, and dictionaries. A](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=69.59) [single element with a trailing comma is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=72.77) [parsed as a single element tuple. This](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=74.48) [leaves us with the problem of how to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=77.42) [specify an empty tuple. In actuality, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=78.61) [answer is simple. We just used empty](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=81.03) [parentheses. In many cases, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=82.71) [parentheses of literal tuples may be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=85.88) [omitted. This feature is often used when](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=87.48) [returning multiple values from a function.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=90.23) [Here we make a function to return the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=92.54) [minimum and maximum values of a sequence,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=94.1) [the hard work being done by two built‑in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=95.97) [functions, min and max. Returning multiple](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=97.98) [values as a tuple is often used in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=102.86) [conjunction with a wonderful feature of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=104.57) [Python called tuple unpacking. Tuple](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=106.1) [unpacking is a destructuring operation,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=108.48) [which allows us to unpack data structures](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=110.33) [into named references. For example, we can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=112) [assign the result of our minmax function](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=115.21) [to two new references like this. When we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=117.08) [print the two objects, we see that the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=120.01) [references have indeed been unpacked from](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=121.58) [the tuples returned from the function.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=123.24) [Unpacking also works with nested tuples.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=126.34) [Here we assigned from a triply nested](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=128.62) [tuple of integers to a triply nested tuple](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=130.44) [of references. As before, we can see that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=132.36) [each of the references has been assigned](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=135.65) [to the corresponding value from the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=137.25) [original tuple. This support for unpacking](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=138.59) [leads to the beautiful Python idiom for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=141.76) [swapping two or more variables. First,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=143.42) [we'll create two references, a and b,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=146.07) [referring to the strings jelly and bean,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=148.2) [respectively. Then we use the form a, b =](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=150.16) [b, a. This first packs a and b into a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=154.305) [tuple on the right side of the assignment.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=157.555) [It then unpacks the tuple on the left,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=159.48) [reusing the names a and b. If we examine a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=161.51) [and b, we can see that they have been](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=165.08) [swapped. Should you need to create a tuple](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=166.44) [from an existing collection object, such](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=170.27) [as a list, you can use the tuple](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=172.01) [constructor. You can also do this with a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=173.46) [string, or indeed, any type over which you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=176.35) [can iterate. Finally, as with most](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=178.43) [collection types in Python, we can test](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=181.27) [for containment using the in operator.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=183.04) [Similarly, we can test for non‑membership with the not in operator.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=1&mode=live&start=186.04)

[Strings](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live)

[We covered strings at some length already,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=1.08) [but we'll take time now to explore their](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=2.89) [capabilities in a little more depth. As](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=4.53) [with any Python sequence, we can determine](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=7.45) [the length of a string with the built‑in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=9.3) [len function. Here we see that the name of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=10.9) [the longest train station in the UK](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=13.86) [contains a whopping 58 characters.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=15.51) [Concatenation of strings is supported](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=18.61) [using the plus (+) operator. We can create](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=20.37) [the string, Newfoundland, by contaminating](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=23.39) [the strings New, found, and land. We can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=25.4) [also use the related augmented assignment](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=28.74) [operator. Here starting with the string](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=30.7) [New, we incrementally add found and land.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=32.88) [Remember that strings are immutable. So](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=36.88) [here the augmented assignment operator is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=38.57) [binding a new string object to s on each](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=40.32) [use. The illusion of modifying s in place](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=42.36) [is achievable because s is a reference to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=45.24) [an object, not an object itself. While the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=47.27) [plus (+) operator is intuitive, you should](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=51.65) [prefer the join method for joining large](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=53.51) [numbers of strings because it is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=55.33) [substantially more efficient. This is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=56.65) [because concatenation using the addition](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=58.72) [(+) operator or it's augmented assignment](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=60.45) [version can lead to the generation of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=62.22) [large numbers of temporaries with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=63.85) [consequent costs for memory, allocations,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=65.7) [and copies. Join is a method on the string](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=67.79) [class, which takes the collection of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=70.85) [strings as an argument and produces a new](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=72.2) [string by inserting a separator between](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=74.05) [each of them. An interesting aspect of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=75.92) [join is how the separator is specified. It](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=77.92) [is the string on which join is called. As](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=80.29) [with many parts of Python, an example is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=84.24) [the best explanation. To join a list of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=86.05) [HTML color code strings into a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=88.27) [semicolon‑separated string, construct a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=90.05) [string containing semicolon and call join](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=92.29) [on it, passing in the list of color](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=94.19) [strings to be joined as an argument. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=95.79) [can then split the colors up again using](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=98.5) [the split method. We've already](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=100.17) [encountered this method, but this time](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=101.91) [we're going to provide it's optional](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=103.32) [argument. A widespread and fast idiom for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=104.54) [contaminating together a collection of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=107.85) [strings is to join using an empty string](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=109.48) [as the separator. The way may not be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=111.62) [obvious at first. To concatenate, invoke](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=117.77) [join on empty text. Something from](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=121.43) [nothing. This use of join is often](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=123.62) [confusing to the uninitiated, but with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=126.45) [use, the approach taken by Python will be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=128.5) [appreciated as natural and elegant.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=130.5) [Another very useful string method is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=134.57) [partition, which divides a string into](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=136.44) [three sections, the part before the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=138.16) [separator, the separator itself, and the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=140.07) [part after the separator. Partition](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=142.11) [returns a tuple, so this is commonly used](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=144.88) [in conjunction with tuple unpacking. Here](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=146.75) [we partition the elements of a travel plan](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=149.63) [into its parts. Often we're not interested](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=151.46) [in capturing the separator value, so you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=155.39) [might see the underscore variable name](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=157.23) [used. This is not treated in a special way](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=158.83) [by the Python language, but there's an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=161.26) [unwritten convention that the underscore](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=162.77) [variable is for unused or dummy values.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=164.41) [This convention is supported by many](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=167.24) [Python‑aware development tools, which will](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=168.81) [suppress unused variable warnings for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=170.63) [underscore. One of the most interesting](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=172.43) [and frequently used string methods is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=176.11) [format. This supersedes, although does not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=177.69) [replace, the string interpolation](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=180.16) [technique used in older versions of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=181.73) [Python, which we do not teach here. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=183.11) [format method can be usefully called on](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=186.42) [any string containing so‑called](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=188.2) [replacement fields, which are surrounded](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=189.68) [by curly braces. The objects provided as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=191.34) [arguments to format are converted to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=194.08) [strings and used to populate these fields.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=195.62) [Here's an example where the arguments to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=198.74) [format the string Jim and the integer 32](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=200.22) [are inserted into the format string. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=202.93) [field names, in this case 0 and 1, are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=205.97) [matched up with the positional arguments](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=208.3) [to format, and each argument is converted](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=209.84) [to a string. The field name may be used](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=211.59) [more than once. Here we use the first](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=214.3) [argument to format twice. However, if the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=216.08) [field names are used exactly once and in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=219.28) [the same order as the arguments, the field](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=221.07) [number can be omitted. If keyword](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=222.85) [arguments are supplied to format, then](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=226.04) [named fields can be used instead of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=227.98) [ordinals. Here the keywords latitude and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=229.12) [longitude are inserted into the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=231.45) [corresponding named replacement fields.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=232.78) [It's possible to index into sequences](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=235.84) [using square brackets inside the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=237.6) [replacement field. Here we index into a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=238.92) [tuple in the replacement fields. You can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=241.03) [even access object attributes. Here we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=243.91) [pass the whole math module to format,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=246.03) [using a keyword argument, remember,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=247.91) [modules are objects, then access two of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=249.69) [its attributes from within the replacement](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=251.9) [fields. Format strings also give us a lot](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=253.5) [of control over field alignment and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=256.59) [floating point formatting. Here are the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=258.19) [same values with the constants displayed](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=259.94) [using only three decimal places. While the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=261.73) [format method we've just covered is quite](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=265.6) [powerful and is generally preferable to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=267.28) [its predecessors, it could be quite](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=268.95) [verbose, even for relatively simple cases.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=270.55) [Consider this example. We assigned 4 times](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=273.03) [20 to the name value. We then interpolate](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=275.25) [value into a string with format, using the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=277.83) [keyword argument matching feature. Here we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=279.77) [have to mention the name value three](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=282.81) [times. Of course, this example could be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=284.95) [made shorter by removing value from the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=286.69) [brackets in the string and not using](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=288.34) [keyword arguments to format. But in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=290.08) [larger, more complex interpolations, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=292.12) [would want to keep those elements in place](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=294.18) [for readability and maintainability. To](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=295.79) [address this, PEP 498 from which this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=299.63) [example is directly drawn, introduces a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=301.82) [new string formatting approach called](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=303.92) [literal string interpolation or, more](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=305.58) [commonly, f‑strings. F‑strings are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=307.46) [available in Python 3.6 and later, and in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=310.46) [the words of PEP 498, they provide a way](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=313.13) [to embed expressions inside literal](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=315.5) [strings using a minimal syntax. An](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=317.12) [f‑string is like a normal string literal,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=320.925) [except that it is prefixed with the letter](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=322.38) [f. Inside the string literal, Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=324.05) [expressions can be embedded inside curly](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=326.45) [braces, and the results of these](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=328.41) [expressions will be inserted into the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=329.91) [string at runtime. Let's rework our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=331.31) [previous example using f‑strings. We again](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=334.46) [assign 4 times 20 to the name value. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=337.18) [then use an f‑string to insert value into](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=340.21) [a string. Here instead of needing to pass](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=342.37) [value into a method, the f‑string simply](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=345.41) [evaluates it as a normal Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=347.55) [expression, inserting the result into the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=349.04) [resulting string. Because f‑strings allow](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=350.81) [you to use any Python expression, you're](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=353.79) [not limited to using simple named](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=355.62) [references. You can, for example, call](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=357.1) [functions. First, let's import the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=359.23) [datetime module. Now we use an f‑string to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=361.39) [report the current time calling](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=364.82) [datetime.datetime.now to get the time,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=366.405) [then formatting it with isoformat. We can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=369.01) [rewrite the math constants example from](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=372.35) [the previous section by simply accessing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=374.07) [math.pi and math.e from within the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=375.91) [f‑string. This then lets us demonstrate](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=378.16) [that, like format, f‑strings also support](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=381.05) [floating point formatting. To print these](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=383.4) [constants with three places of precision,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=386.13) [we can put a colon after the expression in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=388.15) [the f‑string followed by the format](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=389.82) [specifier. These are the essentials of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=392.735) [f‑strings, and this may be all that you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=395.15) [ever need to use. There's quite a bit more](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=396.68) [to know about them, though, and we'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=398.76) [cover f‑strings in greater depth in later](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=400.02) [courses in the core Python series. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=401.89) [recommend you spend some time](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=404.83) [familiarizing yourself with the other](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=406.04) [string methods. Remember, you can find out](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=407.44) [what they are by simply passing str to help.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=2&mode=live&start=409.68)

[Ranges](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live)

[Let's move on and look at range, which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=1.04) [really is a collection rather than a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=2.89) [container. A range is a type of sequence](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=4.27) [used for representing an arithmetic](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=6.86) [progression of integers. Ranges are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=8.39) [created by calls to the range constructor,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=11.51) [and there is no literal form. Most](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=13.75) [typically, we supply only the stop value,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=15.85) [and Python defaults to a starting value of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=17.76) [0. Ranges are sometimes used to create](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=19.595) [consecutive integers for use as loop](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=22.82) [counters. Note that the stop value](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=24.8) [supplied to range is 1 past the end of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=27.4) [sequence, which is why the previous loop](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=29.55) [didn't print 5. We can also supply a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=31.165) [starting value if we wish by passing two](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=34.38) [arguments to range. Wrapping this in a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=36.3) [call to the list constructor is a handy](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=38.97) [way to force production of each item. This](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=40.63) [so‑called half open range convention, with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=43.15) [the stop value not being included in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=45.46) [sequence, may seem strange at first, but](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=47.12) [it actually makes a lot of sense if you're](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=49.61) [dealing with consecutive ranges because](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=51.18) [the end specified by one range is the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=52.84) [start of the next one. Range also supports](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=54.755) [a step argument. Here we count from 0 to 9](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=57.65) [by 2's. Note that in order to use it, you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=60.15) [must supply all three arguments. Range is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=63.05) [curious in that it determines what its](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=67.51499999999999) [arguments mean by counting them. Providing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=68.76) [only one argument means the argument is a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=71.82) [stop value, two arguments are start and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=73.66) [stop, and three arguments are start, stop,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=76.39) [and step. Python range works this way so](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=78.92) [the first argument, start, can be made](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=82.04) [optional, something which isn't normally](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=83.66) [possible. Furthermore, range doesn't](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=85.46) [support keyword arguments. You might](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=87.9) [almost describe it as un‑Pythonic. At this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=89.72) [point, we're going to show you another](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=93.85) [example of poorly styled code, except this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=95.11) [time it's one you can, and should, avoid.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=97.22) [Here's a poor way to print the elements in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=100.04) [a list, by constructing a range over the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=101.655) [length of the list and then indexing into](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=103.54) [the list on each iteration. Although this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=105.21) [works, it's most definitely un‑Pythonic.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=108) [Instead, always prefer to use iteration](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=110.94) [over objects themselves. If, for some](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=113) [reason, you need a counter, you should use](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=117.11) [the built‑in enumerate function, which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=118.75) [returns an iterable series of pairs, each](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=120.44) [pair of being a tuple. The first element](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=122.59) [of the pair is the index of the current](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=124.87) [item and the second element of the pair is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=126.47) [the item itself. Here we construct a list,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=128.39) [passing it to enumerate and iterate over](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=131.55) [the result, giving us the elements of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=133.37) [list with the corresponding positions in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=135.24) [the list. Even better, we can use tuple](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=136.9) [unpacking to avoid having to directly deal with the tuple.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=3&mode=live&start=140.09)

[Lists](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live)

[We've already covered lists a little, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=1.04) [we've been making good use of them. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=2.94) [know how to create lists using the literal](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=4.7) [syntax, add to them using the append](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=6.39) [method, and get at and modify their](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=8.36) [contents using the square brackets](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=10.48) [indexing. Now we'll take a deeper look.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=12) [One very convenient feature of lists and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=15.29) [other Python sequences, for this applies](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=17.3) [to tuples and strings as well, is the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=18.99) [ability to index from the end rather than](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=20.9) [from the beginning. This is achieved by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=22.81) [supplying negative indices. For example,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=25.01) [we can access the last and second‑to‑last](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=27.49) [elements of the list using ‑1 and ‑2. This](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=29.43) [is much more elegant than the clunky](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=33.23) [approach of subtracting 1 from the length](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=34.75) [of a container, the approach you would](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=36.34) [otherwise need to use for retrieving the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=37.75) [last element. Note that indexing with ‑0](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=39.34) [is the same as indexing with 0, returning](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=42.97) [the first element in the list. Because](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=44.91) [there's no distinction between 0 and ‑0,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=46.92) [negative indexing is essentially 1‑based](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=49.120000000000005) [rather than 0‑based. This is good to keep](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=51.3) [in mind if you're calculating indices with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=53.58) [even moderately complex logic. One‑off](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=55.28) [errors can creep into negative indexing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=57.59) [fairly easily. Slicing is a form of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=59.4) [extended indexing, which allows us to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=63.36) [refer to portions of a list. To use it, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=65.02) [pass the start and stop indices of a half](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=67.61) [open range, separated by a colon, as the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=69.62) [square brackets index argument. Here's how](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=71.9) [you can slice the first and second](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=74.68) [elements of a list. See how the second](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=76.17) [index, 3 in this case, is 1 beyond the end](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=78.95) [of the returned range. This facility can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=81.48) [be combined with negative indices. For](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=84.04) [example, to take all elements except the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=86.09) [first and last, use the slice 1:‑1. Both](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=87.86) [the start and stop indices are optional.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=92.51) [To slice all elements from the third to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=94.51) [the end of the list, don't put anything](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=96.16) [after the colon. Similarly, to slice all](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=97.69) [elements from the beginning up to, but not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=100.53) [including the third, don't put a number](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=102.24) [before the colon. Notice that these two](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=103.97) [lists together form the whole list,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=106.62) [demonstrating the convenience of the half](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=108.52) [open range convention. Since both start](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=110.16) [and stop slice indices are optional, it's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=113.08) [entirely possible to omit both and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=114.98) [retrieve all of the elements. And indeed,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=116.77) [this last example is an important idiom](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=119.74) [for copying a list. Recall that assigning](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=121.55) [references never copies an object, but](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=123.92) [merely copies a reference to an object. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=125.74) [deploy the full slice to perform a copy](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=128.96) [into a new list. This gives us a new](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=130.77) [object with a distinct identity, but since](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=132.77) [it's a copy, the new object has an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=135.24) [equivalent value. It's important to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=136.72) [understand that although we have a new](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=139.76) [list object, which can be independently](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=141.2) [modified, the elements within it are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=142.81) [references to the same objects referred to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=144.66) [by the original list. In the event that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=146.53) [these objects are both mutable and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=148.67) [modified, as opposed to replaced, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=150.18) [change will be seen in both lists. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=152.5) [teach this full slice copying idiom](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=155.31) [because you're likely to see it in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=156.95) [wild, and it's not immediately obvious](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=158.16) [what it does. You should be aware that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=160.13) [there are other, more readable ways of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=162.33) [copying a list, such as the copy method,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=163.89) [or you could simply call the list](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=167.04) [constructor passing the list to be copied.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=168.58) [Largely it's a matter of taste. Our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=171.57999999999998) [preference is for the third form, since it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=173.09) [has the advantage of working with any](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=174.69) [iterable series as the source, not just](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=176.18) [lists. You must be aware, however, that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=178.04) [all these techniques perform a shallow](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=181.47) [copy. That is, they create a new list](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=183.16) [containing the same object references as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=185.37) [the source list, but they don't copy the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=187.12) [referred‑to objects. To demonstrate this,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=188.86) [we'll use nested lists with the inner](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=191.59) [lists serving as mutable objects. Here's a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=193.33) [list containing two elements, each of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=195.91) [which is itself a list. We copy this list](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=197.61) [using a full slice and convince ourselves](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=200.64) [that we do, in fact, have distinct lists](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=202.57) [with equivalent values. Notice, however,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=204.32) [that the references within these distinct](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=207.88) [lists refer not only to equivalent](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=209.43) [objects, but, in fact, to the same object,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=211.05) [which we can see using the is operator.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=213.47) [The first elements of a and b are the same](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=216.58) [object until we rebind the first element](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=218.56) [of a to a newly constructed list. Now the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=220.71) [first elements of a and b refer to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=223.47) [different lists with different values. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=224.97) [second elements of both a and b still](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=227.3) [refer to the same object. We'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=229.11) [demonstrate this by mutating that object](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=230.87) [through the a list. We can see this change](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=232.6) [reflected through the b list. For](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=235.43) [completeness, here is the final state of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=237.83) [both the a and b lists. If you need to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=239.63) [perform true deep copies of hierarchical](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=242.81) [data structures like this, which in our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=244.78) [experience is a rarity, we recommend](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=246.42) [taking a look at the copy module in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=248.59) [Python standard library. As with strings](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=250.25) [and tuples, lists support repetition using](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=254.4) [the multiplication operator. It's simple](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=256.6) [enough to use, although it's rarely](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=258.7) [spotted in the wild in this form. It's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=260.06) [most often useful for initializing a list](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=262.97) [of a size known in advance, with a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=264.92) [constant value, such a 0. Be aware,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=266.41) [though, that when using mutable objects as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=269.59) [elements, the same trap for the unwary](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=271.2) [lurks here, since repetition will repeat](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=273.09) [the reference without copying the value.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=274.97) [Let's demonstrate using nested lists as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=276.995) [our mutable elements again. If we now](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=279.21) [modify the third element of our outer](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=281.73) [list, we can see the change through all](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=283.39) [five references, which comprise the outer](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=285.6) [list elements. This is because each](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=287.4) [element of the outer list is a reference](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=289.57) [to the same nested list. To find the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=291.21) [element in the list, use the index method,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=295.15) [passing the object you're searching for.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=297.13) [The elements are compared for equivalents](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=298.78999999999996) [until the one you're looking for is found.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=300.71) [Here we create a string and split it on](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=302.82000000000005) [spaces, giving us a list of strings. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=305.11) [then use the index method on that list to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=308.3) [find the index of the word fox. If you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=310.37) [search for a value that isn't present, you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=313.24) [receive a value error. Another means of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=315.05) [searching is to count matching elements.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=317.77) [Here we count how many times the word](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=319.71) ['the' appears in our list. If you just](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=321.38) [want to test for membership, you can use](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=324.24) [the in operator, or you could test for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=325.86) [non‑membership with not in. You can remove](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=329.09) [elements from a list using a keyword with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=333.19) [which we have not yet become acquainted,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=334.98) [del. The del keyword takes a single](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=336.61) [parameter, which is a reference to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=339.03) [list element, and removes it from the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=340.49) [list, shortening the list in the process.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=341.89) [Here we again construct a list by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=344.84) [splitting a string. We then remove the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=346.44) [fourth element by calling del U [3]. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=349) [can see that the element has been removed.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=352.47) [It's also possible to remove elements by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=355.04) [value rather than by position by using the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=356.87) [remove method. This is, of course,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=359.17) [equivalent to passing the result of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=361.97) [index method to del. This also raises a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=363.5) [value error if a matching element is not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=366.44) [present. Items can be inserted into lists](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=368.18) [using the insert method, which accepts the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=372.23) [index of the new item and the new item](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=374.06) [itself. We'll again start with a list of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=375.77) [strings. We'll then insert the string](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=378.43) ['destroyed' at index 2. If we join the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=381.06) [list into a single string, we see that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=384.08) [someone has made a terrible mistake.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=385.79) [Concatenating lists using the addition](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=388.39) [operator results in a new list without](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=390.17) [modification of the operands, whereas the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=391.89) [augmented assignment operator, +=,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=394.39) [modifies the assignee in place. This can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=396.45) [also be achieved using the extend method.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=399.72) [All of these techniques work with any](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=402.54) [iterable series on the right‑hand side.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=404.15) [Before we move on from lists, let's look](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=407.84) [at two operations which rearranged the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=409.6) [elements in place, reversing and sorting.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=411.22) [A list can be reversed in place simply by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=414.14) [calling its reverse method. A list can be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=416.07) [sorted in place using the sort method. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=418.77) [sort method accepts two optional](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=421.9) [arguments, key and reverse. The latter is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=423.42) [self‑explanatory, and when set to true](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=426.31) [gives it ascending sort. The key parameter](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=428.41) [is more interesting. It accepts any](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=431.55) [callable object, which is then used to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=433.55) [extract a key from each item. The items](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=435.29) [will then be sorted according to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=437.92) [relative ordering of these keys. There are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=439.23) [several types of callable objects in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=441.46) [Python, although the only one we have](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=443.03) [encountered so far is the humble function.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=444.65) [For example, the len function is a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=447.54) [callable object, which is used to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=449.2) [determine the length of a collection, such](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=450.51) [as a string. Consider the following list](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=452.11) [of words. We can sort this list by the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=454.67) [length of the strings by passing len as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=457.54) [the key argument to sort. Sometimes an in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=459.34) [situ sort or reversal is not what's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=463.39) [required. For example, it may cause a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=465.17) [function argument to be modified, giving](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=467.31) [the function confusing side effects which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=469.08) [we'd not otherwise have. For out‑of‑place](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=470.84) [equivalents of the reverse and sort list](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=473.34) [methods, we can use the reversed and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=475.07) [sorted built‑in functions. These return a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=477.02) [reversed iterator and a newly sorted list,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=479.54) [respectively. For example, calling sorted](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=481.92) [on the list 4, 9, 2, 1 results in an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=485.24) [entirely new list with the correctly](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=487.85) [sorted elements. Calling reversed on a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=489.41) [list doesn't give us a new list. Rather,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=492.28) [it gives us an object of the type](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=494.39) [list\_reverseiterator. We can pass this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=495.74) [iterator to the list constructor to create](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=498.81) [an actual list. These functions have the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=500.59) [advantage that they'll work on any finite, iterable source object.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=4&mode=live&start=503.07)

[Dictionaries](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live)

[We'll now return to dictionaries, which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=1.09) [lie at the heart of many Python programs,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=2.67) [including the Python interpreter itself.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=4.57) [We briefly looked at literal dictionaries](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=7.34) [previously, seeing how they were delimited](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=9.01) [with curly braces and contain](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=10.9) [comma‑separated key‑value pairs with each](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=12.32) [pair tied together by a colon. These](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=14.62) [values are accessible via the keys. Since](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=17.28) [each key is associated with exactly one](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=19.82) [value and lookup is through keys, the keys](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=21.74) [must be unique within any single](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=23.91) [dictionary. It's fine, however, to have](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=25.28) [duplicate values. Internally, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=27.25) [dictionary maintains pairs of references](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=29.98) [to the key objects and the value objects.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=31.77) [The key objects must be immutable, so](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=34.02) [strings, numbers, and tuples are fine, but](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=35.97) [lists are not. The value objects can be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=38.06) [mutable, and in practice often are. Our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=40.74) [example URL map uses strings for both keys](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=43.23) [and values, which is fine. You should](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=45.73) [never rely on the order of the items in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=47.67) [the dictionary. It's essentially random](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=49.42) [and may even vary between different runs](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=51.38) [of the same program. As for the other](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=53.05) [collections, there's also a dict](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=56.2) [constructor, which can convert other types](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=57.58) [to dictionaries. We can use the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=59.4) [constructor to convert from an iterable](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=61.81) [series of key‑value pairs stored in tuples](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=63.205) [like this. Recall that the items in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=65.4325) [dictionary are not stored in any](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=68.04) [particular order. So long as the keys are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=69.48) [legitimate Python identifiers, it's even](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=72.38) [possible to create a dictionary directly](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=74.15) [from keyword arguments passed to the dict.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=75.84) [As with lists, dictionary copying is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=78.7425) [shallow by default, copying only the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=81.79) [references to the key and value objects,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=83.55) [not the objects themselves. There are two](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=85.53) [means of copying a dictionary, of which we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=88.93) [most commonly see the second. The first](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=90.68) [technique is to use the copy method. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=92.75) [second is simply to pass an existing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=96.49) [dictionary to the dict constructor. If you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=98.07) [need to extend the dictionary with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=101.59) [definitions from another dictionary, you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=102.82) [can use the update method. This is called](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=104.41) [on the dictionary to be updated and is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=106.52) [passed the contents of the dictionary](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=108.15) [which is to be merged in. If we create a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=109.61) [new dictionary and then update our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=112.85) [original dictionary with the new one, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=114.36) [can see the elements of the new dictionary](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=116.08) [in the original. If the argument update](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=117.6) [includes keys which are already present in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=120.43) [the target dictionary, the values](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=122.15) [associated with these keys are replaced in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=123.69) [the target by the corresponding values](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=125.47) [from the source. If we start with the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=126.99) [dictionary of stock prices, we can update](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=128.97) [one entry and add another with update. As](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=131.34) [we've seen in an earlier module,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=135.56) [dictionaries are iterable so can be used](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=137.10500000000002) [with for loops. The dictionary yields the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=138.73) [next key on each iteration, and we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=140.76) [retrieve the corresponding value by lookup](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=142.48) [using the square brackets operator. If we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=144.34) [start with the dictionary of color names](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=146.49) [to codes, we could iterate over the keys,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=147.92) [looking up the codes with them. Notice](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=151.38) [that the keys are returned in an arbitrary](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=153.99) [order, which is neither the order in which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=155.73) [they were specified nor any other](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=157.2) [meaningful order. If we want to iterate](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=158.71) [over only the values, we can use the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=160.91) [values dictionary method. This returns an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=162.62) [object which provides an iterable view](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=165.34) [onto the dictionary values without causing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=167.07) [the values to be copied. There is no](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=169.01) [efficient or convenient way to retrieve](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=171.62) [the corresponding key from a value, so we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=173.23) [only print the values. In the interest of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=175.18) [symmetry, there is also a keys method.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=178.1) [Often, though, we want to iterate over the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=181.44) [keys and values in tandem. Each key‑value](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=183) [pair in a dictionary is called an item,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=185.7) [and we can get hold of an iterable view of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=187.38) [items using the items dictionary method.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=188.97) [When iterated, the items view yields each](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=192.24) [key‑value pair as a tuple. By using tuple](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=194.46) [unpacking in the for statement, we can get](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=198.21) [both key and value in one operation](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=199.85) [without the extra lookup. The membership](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=201.83) [tests for dictionaries using the in and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=205.03) [not in operators work on the keys. To see](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=206.96) [this, let's construct a dictionary mapping](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=209.64) [currency names to symbols. We can then use](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=211.12) [in to see if New Zealand dollars are in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=214.25) [the dictionary. Likewise, we can use not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=216.08) [in to see that Macedonian denars are not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=218.64) [present. As with lists, we use the del](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=220.68) [keyword to remove an entry from a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=224.49) [dictionary. If we create a dictionary of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=225.8) [elements and their atomic numbers, we can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=228.47) [remove Feynmanium by deleting the key Fy.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=231.08) [The keys in a dictionary should be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=235.73) [immutable, although the values can be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=237.06) [modified. Here's a dictionary which maps](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=238.54) [the element symbol to a list of mass](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=240.66) [numbers for different isotopes of that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=242.17) [element. See how we split the dictionary](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=243.61) [literal over multiple lines. That's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=246.29) [allowed because the curly braces for the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=248.31) [dictionary literal are open. Our string](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=249.77) [keys are immutable, which is a good thing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=252.44) [for correct functioning of the dictionary.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=254.17) [But there's no problem with modifying the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=256.54) [dictionary values in the event, for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=258.09) [example, that we discover some new](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=259.61) [isotopes. Here the augmented assignment](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=260.95) [operator is applied to the list object](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=263.83) [accessed through H, the key for hydrogen.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=265.81) [The dictionary is not being modified. Of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=268.25) [course, the dictionary itself is mutable,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=270.64) [and we can add new items. With compound](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=272.34) [data structures such as our table of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=276.15) [isotopes, it can be helpful to have them](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=277.58) [printed out in a much more readable form.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=279.18) [We can do this with the Python standard](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=281.44) [library pretty‑printing module called](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=282.89) [pprint, which contains a function called](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=284.59) [pprint. Note that if we didn't bind the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=286.54999999999995) [pprint function to the different name pp,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=289.415) [the function reference would overwrite the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=291.62) [module reference, preventing further](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=293.13) [access to contents of the module.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=294.64) [Arguably, it's poor design to have a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=296.56) [module containing functions of the same](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=298.06) [name because of this issue. Be that as it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=299.91) [may, the pprint function gives us a much](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=301.92) [more comprehensible display. Let's move on](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=303.76) [from dictionaries and look at a new built‑in data structure, the set.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=5&mode=live&start=307.26)

[Sets](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live)

[The set data type is an unordered](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=1.04) [collection of unique elements. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=2.77) [collection is mutable, insofar as elements](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=4.73) [could be added and removed from the set.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=6.72) [But each element must itself be immutable,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=8.6) [very much like the keys of a dictionary.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=10.97) [Sets have a literal form very similar to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=14.77) [dictionaries. Again, delimited by curly](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=16.64) [braces, but each item is a single object](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=18.58) [rather than a pair joined by a colon. Note](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=20.62) [that the set is unordered and, of course,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=23.8) [our set has the type set. Recall that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=26.66) [curly braces create an empty dictionary.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=30.58) [So in order to create an empty set, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=33.44) [must resort to the set constructor. This](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=35) [is also the form that Python echoes back](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=37.91) [to us. The set constructor can create a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=39.64) [set from any iterable series, such as a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=42.9) [list, and duplicates are discarded. In](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=44.75) [fact, a common use of sets is to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=47.58) [efficiently remove duplicate items from a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=49.11) [series of objects. Naturally, sets are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=50.78) [iterable, although the order is arbitrary.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=54.85) [Membership is a fundamental operation for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=57.995000000000005) [sets and, as with other collection types,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=60.54) [is performed using the in and not in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=62.31) [operators. To add a single element to a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=64.26) [set, use the add method. Adding an element](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=68.1) [that already exists has no effect and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=71.33) [neither doesn't produce an error. Multiple](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=73.25) [elements could be added in one go from any](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=75.92) [iterable series, including another set](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=77.66) [using the update method. Two methods are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=79.63) [provided for removing elements from sets.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=83.43) [The first, remove, requires that the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=85.84) [element to be removed is present in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=87.87) [set. Otherwise, a key error is produced.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=89.44) [The second method, discard, is less fussy](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=92.64) [and simply has no effect if the element is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=94.71) [not a member of the set. As with the other](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=96.42) [built in collections, set sports a copy](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=100.24) [method, which performs a shallow copy of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=102.27) [the set, copying references but not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=103.91) [objects. And as we've already shown, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=105.57) [set constructor may be used. Perhaps the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=108.6) [most useful aspect of the set type is the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=112.32) [group of powerful set algebra operations,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=114.19) [which are provided. These allow us to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=116.11) [easily compute set unions, set differences](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=118.14) [and set intersections, and to evaluate](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=120.46) [whether two sets have subset, superset, or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=122.31) [disjoint relations. To demonstrate these](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=124.41) [methods, we'll construct some sets of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=127.85) [people according to various phenotypes.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=129.65) [We'll identify a few people with blue eyes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=132.14) [and a few with blond hair. The smell\_hcn](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=135.14) [set contains those who can smell hydrogen](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=138.025) [cyanide. And taste\_ptc is those who can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=140.445) [taste phenylthiocarbamide. Finally, we'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=143.905) [define a set for those with O blood type,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=146.7796875) [one for B blood type, one for A blood](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=149.29000000000002) [type, and finally one for AB blood. To](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=151.9) [find all the people with blond hair, blue](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=156.52) [eyes, or both, we can use the union](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=158.34) [method, which collects together all the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=160.06) [elements which are in either or both sets.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=161.56) [We can demonstrate that union is a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=165.14) [commutative operation, that is, we can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=166.56) [swap the order of the operands using the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=168.37) [value of quality operator to check for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=170.47) [equivalents of the resulting sets. To find](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=172.23) [all the people with blond hair and blue](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=176.45) [eyes we can use the intersection method,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=178.07) [which collects together only the elements](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=179.78) [which are present in both sets. This is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=181.53) [also commutative. To identify the people](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=183.91) [with blond hair who don't have blue eyes,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=187.79) [we can use the difference method. This](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=189.71499999999997) [finds all the elements which are in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=191.92) [first set, which are not in the second](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=193.24) [set. This is non‑commutative because the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=194.75) [people with blond hair who don't have blue](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=197.41) [eyes are not the same as the people who](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=199.15) [have blue eyes but don't have blond hair.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=200.77) [However, if we want to determine which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=204.54) [people have exclusively blonde hair or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=206.09) [blue eyes, but not both, we can use the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=207.98) [symmetric difference method. This collects](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=210.02) [all the elements which were in the first](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=212.59) [set or the second set, but not both, As](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=213.98) [you can tell from the name, symmetric](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=217.27) [difference is indeed commutative. In](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=218.71) [addition, three predicate methods are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=222.4) [provided, which tell us about the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=224) [relationships between sets. We can check](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=225.17) [whether one set is a subset of another](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=228.1) [using the issubset method. For example, to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=229.67) [check whether all of the people who can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=232.23) [smell hydrogen cyanide also have blond](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=233.49) [hair, we can call issubset on smell\_hcn,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=235.47) [passing blond\_hair as a parameter. This](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=237.895) [checks that all the elements of the first](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=241.57) [set are also present in the second set. To](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=243.03) [test whether all the people who could](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=245.88) [taste phenylthiocarbamide can also taste](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=247.04) [hydrogen cyanide, use the issuperset](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=249.07) [method. This checks that all the elements](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=251.15) [of the second set are present in the first](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=253.8) [set. To test that two sets have no members](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=255.39) [in common, use the isdisjoint method. For](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=258.52) [example, your blood type is either A or O, never both.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=6&mode=live&start=261.11)

[Protocols](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live)

[In Python, a protocol is a set of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=1.04) [operations or methods that a type must](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=2.73) [support if it is to implement that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=4.56) [protocol. Protocols needn't be defined in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=5.95) [the source code as separate interfaces or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=8.65) [base classes as they would in nominally](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=10.28) [typed languages, such as C# or Java. It's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=12.08) [sufficient to simply have an object](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=14.57) [provide functioning implementations of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=16) [those operations. We can organize the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=17.49) [different collections we have encountered](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=21.25) [in Python according to which protocols](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=22.49) [they support. Support for a protocol](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=24.06) [demands specific behavior from a type. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=26.37) [container protocol requires that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=29.27) [membership testing using the in and not in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=30.69) [operators be supported. The sized protocol](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=32.78) [requires that the number of elements in a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=36.65) [collection can be determined by calling](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=38.03) [len on the collection. Iteration is such](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=39.59) [an important concept that we're devoting a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=43.18) [whole module to it later in this course.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=44.69) [In short though, iterables provide a means](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=46.74) [for yielding elements one by one as they](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=48.73) [are requested. One important property of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=50.57) [iterables is that they can be used in for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=52.87) [loops. The sequence protocol requires that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=54.42) [items can be retrieved using square](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=57.91) [brackets with an integer index, that items](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=59.32) [can be searched for with index, that ideas](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=62.3) [can be counted with count, and that a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=65.32) [reversed copy of the sequence can be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=67.985) [produced with reversed. In addition,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=69.18) [objects that support sequence must also](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=73.3) [support iterable, sized, and container. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=75.1) [won't cover the mutable sequence, mutable](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=79.04) [mappings, and immutable set here. We have](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=80.84) [only covered one representative type of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=82.92) [each protocol so the generality afforded](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=84.58) [by the protocol concept doesn't gain as much at this juncture.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=7&mode=live&start=86.52)

[Summary](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live)

[Python's built‑in collection types are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=1.04) [generally intuitive for most purposes, but](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=2.47) [they're also quite sophisticated, so we've](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=4.63) [had to go through a lot of material in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=6.59) [this module. Here are the topics we've](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=7.98) [covered. Tuples, or immutable sequence](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=9.81) [types. Literal syntax for tuples are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=12.75) [optional parentheses around a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=15.72) [comma‑separated list. For single‑element](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=17.06) [tuples, you need to use a trailing comma.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=20.11) [Tuple unpacking is useful for multiple](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=23.14) [return values and swapping. Join](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=24.93) [concatenation is most efficiently](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=27.72) [performed with the join method rather than](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=29.14) [the addition or augmented assignment](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=31.12) [operators. The str.partition method is a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=32.62) [useful and elegant string parsing tool.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=35.81) [The str.format method provides a powerful](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=38.64) [means of replacing placeholders with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=40.52) [stringified values. Python 3.6 introduced](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=42.03) [f‑strings, a new kind of string literal](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=45.46) [that can interpolate Python expressions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=47.69) [into the string. Range objects represent](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=49.23) [arithmetic progressions. Range can be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=52.2) [called with one, two, or three arguments](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=54.95) [describing start, stop, and step values.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=57.02) [The enumerate built‑in function is often a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=60.84) [superior alternative to range for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=62.57) [generating loop counters. Lists support](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=64.19) [indexing from the end of the list with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=67.27) [negative indices. Slice syntax allows us](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=68.83) [to copy all or part of a list. The full](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=72.17) [slice is a common Python idiom for copying](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=75.85) [lists, although the copy method and list](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=77.33) [constructor are less obscure. You can look](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=79.23) [for elements in a list with the index and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=82.06) [count methods. You can remove elements](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=83.78) [from a list with the del keyword. Lists](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=86.5) [can be sorted or reversed in place with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=89.65) [the sort and reverse methods. The sorted](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=91.43) [and reversed functions can sort or reverse](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=94.73) [any iterable. List copies and those of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=96.75) [other collections in Python are shallow](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=99.67) [copies. References are copied, but objects](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=101.31) [are not. Dictionaries map from keys to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=103.315) [values. Iteration and membership testing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=106.47) [with dictionaries is done with respect to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=109.54) [their keys. You should not assume any](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=111.07) [order when iterating over keys in a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=113.81) [dictionary. The keys, values and items](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=115.21) [methods provide views into the different](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=118.38) [aspects of a dictionary, allowing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=119.96) [convenient iteration. You can copy](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=121.58) [dictionaries with the copy method or the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=124.31) [dict constructor. The update method on](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=125.92) [dictionary extends one dictionary with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=129.02) [another. Sets store an unordered](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=130.62) [collection of unique elements. Sets](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=133.34) [support powerful set algebra operations](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=136.22) [and predicates. The built‑in collections](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=138.25) [can be organized according to which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=140.95) [protocols they support, such as iterable,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=142.25) [sequence, and mapping. In passing, we've](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=144.4) [also found that underscore is in common](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=147.16) [usage used for dummy or superfluous](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=149.21) [variables. The pprint module supports](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=151.15) [pretty printing of compound data](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=154.18) [structures. In the next module of Core](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=155.51) [Python: Getting Started, we'll look at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=158.87) [exceptions and how to work with them in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=160.23) [Python. Thanks for watching, and we'll see you in the next module.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=63a3ef3c-d811-41f4-87b7-bd530da2ca63&clip=8&mode=live&start=161.64)

[Exceptions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live)

[Overview](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live)

[In most programs, there is a clear notion](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=1.04) [of the normal path through the code. But,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=3.3) [of course, conditions can arise where this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=5.51) [normal flow can't be followed. For](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=7.26) [example, if a program involves reading a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=9.52) [file specified by the user, it may](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=11.34) [actually happen that the file doesn't](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=13.57) [exist. Conditions like this often need to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=15.11) [be handled, and the standard mechanism for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=17.88) [doing so in Python, as with many other](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=19.84) [languages, is with what are known as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=21.92) [exceptions. In this module of Core Python:](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=23.71) [Getting Started, we will learn what](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=27.04) [exceptions are. We'll see how to introduce](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=28.71) [or raise an exception, and we'll look at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=31.23) [how doing so interrupts the normal flow of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=33.64) [a program. We'll learn about how you can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=35.54) [catch exceptions to handle them, and we'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=37.93) [see what happens to your program if you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=40.17) [choose not to handle exceptions. We'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=41.71) [talk a bit about Python's somewhat liberal](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=44.66) [approach to the use of exceptions. We'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=46.65) [explore some of Python's built‑in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=48.96) [exception types, and we'll see that some](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=50.32) [of these indicate programmer errors, while](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=52.32) [others represent various other kinds of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=54.4) [conditions. And we'll look at an important](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=56.19) [mechanism for ensuring resource cleanup](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=58.88) [when exceptions are involved. Exception](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=60.87) [handling is a mechanism for stopping](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=65.07) [normal program flow and continuing at some](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=66.49) [surrounding context or code block. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=68.52) [event of interrupting normal flow is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=71.2) [called the act of raising an exception. In](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=72.7) [some enclosing context, the raised](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=75.04) [exception must be handled upon which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=76.72) [control flow is transferred to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=78.92) [exception handler. If an exception](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=80.32) [propagates up the callstack to the start](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=83.01) [of the program, then an unhandled](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=84.88) [exception will cause the program to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=86.53) [terminate. An exception object containing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=87.92) [information about where and why an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=90.99) [exceptional event occurred is transported](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=92.61) [from the point at which the exception was](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=94.92) [raised to the exception handler so that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=96.43) [the handler can interrogate the exception](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=98.65) [object and take appropriate action. If](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=100.27) [you've used exceptions in other popular](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=103.41) [imperative languages like C++ or Java,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=105.04) [then you've already got a good idea of how](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=107.56) [exceptions work in Python. There have been](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=109.11) [long and tiresome debates over exactly](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=112.47) [what constitutes an exceptional event, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=114.55) [core issue being that exceptionality is in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=116.77) [reality a matter of degree. Some things](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=119.04) [are more exceptional than others, whereas](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=121.36) [programming languages tend to impose a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=123.54) [false dichotomy by insisting that an event](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=125.12) [is either entirely exceptional or not at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=127.31) [all exceptional. The Python philosophy is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=129.4) [at the liberal end of the spectrum when it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=132.18) [comes to the use of exceptions. Exceptions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=133.77) [are ubiquitous in Python, and it's crucial to understand how to handle them.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=0&mode=live&start=135.93)

[Exceptions and Control Flow](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live)

[Since exceptions are a means of control](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=1.09) [flow, they can be clumsy to demonstrate at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=2.79) [the REPL. So for this part of the course,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=4.86) [we'll be using a Python module to contain](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=6.74) [our code. Let's start with a very simple](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=8.56) [module we can use for exploring these](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=11.13) [important concepts and behaviors. Place](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=12.75) [this code in a module called](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=15.57) [exceptional.py. We'll define a function](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=16.92) [called convert that attempts to construct](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=19.73) [an integer from a sequence of strings](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=21.47) [describing its decimal digits. It then](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=23) [returns that intege. Import the convert](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=25.97) [function from this module into the Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=29.04) [REPL and call our function to see that it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=30.72) [has the desired effect. This seems to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=32.68) [work, but if we call our function with an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=36.6) [object that can't be converted to an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=38.76) [integer, we get a trace back from the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=40.39) [dictionary lookup. What's happened here is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=42.52) [that digit map raised a key error when we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=44.59) [tried to look up the string around in it.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=46.72) [Of course, it did this because it doesn't](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=49.1) [have an entry for around. We didn't have a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=50.73) [handler in place, so the exception was](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=52.92) [caught by the REPL and the stack trace was](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=54.66) [displayed. The key error referred to in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=56.42) [the stack trace is the type of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=59.19) [exception object, and the error message,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=60.75) [the string around, is part of the payload](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=62.730000000000004) [of the exception object that has been](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=65.32) [retrieved and printed at the REPL. Notice](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=66.63) [that the exception propagates across several levels in the call stack.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=1&mode=live&start=70.71)

[Handling Exceptions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live)

[Let's make our convert function more](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=1.08) [robust by handling the KeyError using a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=2.61) [try except construct. Both the try and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=4.98) [except keywords introduce new blocks. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=8.06) [try block contains code that could raise](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=10.47) [an exception, and the except block](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=12.19) [contains the code, which performs error](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=13.93) [handling in the event that an exception is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=15.5) [raised. Modify your convert function to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=17.33) [look like this. We have decided that if an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=19.65) [unconvertible string is supplied, will](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=22.58) [return ‑1. To reinforce your understanding](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=24.61) [of the control flow here, we'll add a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=28.05) [couple of print statements. Let's test](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=29.66) [this interactively after restarting the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=33.37) [REPL. First, we import the convert](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=35.12) [function from a module named exceptional.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=37.36) [Then, we convert the string three four](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=39.94) [into the number 34. Finally, we try to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=41.99) [convert the word eleventeen, which, of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=45.21) [course, fails. Note how the print in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=47.17) [try block, after the point at which the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=50.36) [exception was raised, was not executed](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=51.91) [when we passed in eleventeen. Instead,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=54.13) [execution was transferred directly to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=57.08) [first statement of the except block. Our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=58.99) [function expects its argument s to be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=61.33) [iterable, so let's see what happens if we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=63.37) [pass an object that isn't, for example, an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=65.04) [integer. This time our handler didn't](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=67.22) [intercept the exception. If we look](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=70.17) [closely at the trace, we can see that this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=72.14) [time we received a TypeError, a different](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=74.08) [type of exception. Each try block can have](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=76.2) [multiple corresponding except blocks,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=78.88) [which intercept exceptions of different](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=80.83) [types. Let's add a handler for TypeError,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=82.39) [too. Now, if we rerun the same test in a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=85.03) [fresh REPL, we find that the TypeError is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=88.4) [handled as well. We've got some code](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=90.61) [duplication between our two exception](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=94.24) [handlers with that duplicated print](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=95.8) [statement and assignment. We'll move the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=97.29) [assignment in front of the try block,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=99.24) [which doesn't change the behavior of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=100.77) [program. Then we'll exploit the fact that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=102.22) [both handlers do the same thing by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=104.75) [collapsing them into one, using the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=106.44) [ability of the except statement to accept](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=108.08) [a tuple of exception types. Now we see](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=109.95) [that everything still works as designed.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=113.43) [We can convert the string two nine, but](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=115.64) [converting the word elephant or the integer 451 will fail and return ‑1.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=2&mode=live&start=117.99)

[Exceptions and Programmer Errors](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live)

[Now that we are confident with the control](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=1.14) [flow for exception behavior, we can remove](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=2.78) [the print statements. But now, when we try](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=4.88) [to import our program, we get yet another](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=7.8) [type of exception, an IndentationError,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=9.89) [because our except block is now empty, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=12.04) [empty blocks are not permitted in Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=14.13) [programs. This is not an exception that it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=15.8) [is ever useful to catch with an except](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=18.8) [block. Almost anything that goes wrong](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=20.55) [with a Python program results in an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=22.49) [exception. But some, such as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=23.95) [IndentationError, SyntaxError, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=25.82) [NameError are the result of programmer](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=27.97) [errors, which should be identified and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=30.03) [corrected during development rather than](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=31.54) [handled it runtime. The fact that these](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=33.2) [things are exceptions is mostly useful if](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=35.72) [you're creating a Python development tool,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=37.65) [such as a Python IDE, embedding Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=39.3) [itself in a larger system to support](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=41.55) [application scripting, or designing a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=43.23) [plugin system which dynamically loads](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=45.16) [code. With that said, we still have the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=46.79) [problem of what to do with our empty](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=50.32) [except block. The solution arrives in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=51.7) [form of the pass keyword, which is a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=54.12) [special statement that does precisely](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=55.95) [nothing. It's a no‑op, and its only](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=57.59) [purpose is to allow us to construct](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=59.93) [syntactically permissible blocks that are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=61.5) [semantically empty. Perhaps in this case,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=63.35) [though, it would be better to simplify](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=67.41) [further and just use multiple return](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=68.92) [statements and do away with the x variable](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=70.64) [completely. Sometimes we'd like to get](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=72.62) [hold of the exception object, in this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=76.51) [case, an object of type of KeyError or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=78.31) [AttributeError, and interrogate it for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=80.47) [more details of what went wrong. We can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=82.37) [get a named reference to the exception](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=85.26) [object by tacking an as clause onto the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=86.86) [end of the except a statement. We'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=89.02) [modify our function to print a message](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=91.32499999999999) [with exception details to the standard](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=93.06) [error stream before returning. To print a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=94.64) [standard error, we need to get a reference](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=97.04) [to the stream from the sys module, so at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=98.79) [the top of our module we'll need to import](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=100.72) [sys. We can then pass sys.stderr as a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=102.75) [keyword argument called file to print.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=106.58) [Here we use a feature of f strings that we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=109.64) [haven't seen before. If you put an !r](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=111.54) [after the expression, the repr](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=114.44) [representation of the value will be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=115.94) [inserted into your string. In the case of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=117.52) [exceptions, this gives us more detailed](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=119.89) [information about the type of the exception. Let's see that at the REPL.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=3&mode=live&start=122)

[Re-raising Exceptions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live)

[Let's add a second function, string\_log,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=1.04) [to our module, which calls our convert](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=3.08) [function and computes the natural log of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=4.81) [the result. We've written this fairly](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=6.6) [innocuous looking bit of code to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=9.97) [demonstrate the greatest folly of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=11.47) [returning error codes, that they can be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=12.91) [ignored by the caller, wreaking havoc](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=14.89) [amongst unsuspecting code later in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=16.69) [program. A slightly better program might](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=18.55) [test the value of v before proceeding to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=21.58) [the log call. Without such a check, log](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=23.45) [will, of course, fail when passed the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=26.87) [negative error code value. Naturally, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=28.44) [log failure causes the raising of another](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=31.04) [exception. Much better and altogether more](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=33.01) [Pythonic is to forget about error return](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=36.06) [codes completely and go back to raising an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=38.11) [exception from convert. Instead of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=40.06) [returning an un‑Pythonic error code, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=44.68) [can simply omit our error message and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=46.67) [re‑raise the exception object we're](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=48.45) [currently handling. This can be done by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=49.93) [replacing the return a ‑1 with raise at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=52.04) [the end of our exception handling block.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=54.98) [Without a parameter, raise simply](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=57.58) [re‑raises the exception that is being](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=59.4) [currently handled. Testing in the REPL, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=60.98) [can see that the original exception type](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=66.46) [is re‑raised whether it's a key error or a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=68.06) [type error, but our Conversion error](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=71.59) [message is printed to standard error along the way.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=4&mode=live&start=73.45)

[Exceptions Are Part of the API](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live)

[Exceptions form an important aspect of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=1.04) [API of a function. Callers of a function](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=3.21) [need to know which exceptions to expect](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=5.94) [under various conditions so that they can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=7.88) [ensure appropriate exception handlers are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=9.92) [in place. We'll use square root finding as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=11.68) [an example, using a homegrown square root](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=15.22) [function, courtesy of Heron of Alexandria,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=17.53) [although he probably didn't use Python.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=19.86) [Place the following code in a file named](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=22.61) [roots.py. There's only one language](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=24.56) [feature in this program we haven't met](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=29.01) [yet, the logical and operator, which we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=30.6) [use in this case to test that two](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=33.17) [conditions are true on each iteration of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=34.78) [the loop. Python also includes a logical](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=36.87) [or operator, which can be used to test](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=39.9) [whether either or both operands are true.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=41.79) [Running our program, we can see that Heron](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=45.24) [was really onto something. Let's add a new](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=47.35) [line to the main function, which takes the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=51.16) [square root of ‑1. If we run that, we get](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=52.93) [a new exception. What has happened is that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=56.52) [Python has intercepted a division by 0,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=59.51) [which occurs on the second iteration of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=61.77) [the loop and raised an exception, a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=63.53) [ZeroDivisionError. Let's modify our code](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=65.53) [to catch the exception before it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=69.21) [propagates up to the top of the call](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=70.51) [stack, thereby causing our program to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=71.97) [stop, using the try‑except construct. Now,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=73.64) [when we run the script, we see that we're](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=78.66) [handling the exception cleanly. We should](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=80.2) [be careful to avoid a beginner's mistake](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=84.01) [of having too‑tight scopes for exception](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=85.88) [handling blocks. We can easily use one](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=87.8) [try‑except block for all of our calls to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=90.31) [square root. We also add a third print](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=92.39) [statement to show how execution of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=95.17) [enclosed block is terminated. This is an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=96.96) [improvement on what we started with but](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=101.11) [most likely, users of a square root](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=102.9) [function don't expect it to throw a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=104.61) [ZeroDivisionError. Python provides us with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=106.22) [several standard exception types to signal](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=108.82) [common errors. If a function parameter is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=110.68) [supplied with an illegal value, it is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=113.39) [customary to raise a ValueError. We can do](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=115.52) [this by using the raise keyword with a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=118.8) [newly created exception object, which we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=120.77) [can create by calling the ValueError](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=122.78) [constructor. There are two places we could](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=124.51) [deal with the division by 0. The first](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=128.37) [approach would be to wrap the root finding](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=130.82) [while loop in a try‑except](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=132.57) [ZeroDivisionError construct and then raise](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=134.19) [a new ValueError exception from inside the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=136.59) [exception handler. This would be wasteful,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=138.64) [though. We know this routine will fail](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=141.44) [with negative numbers so we can detect](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=143.68) [this precondition early on and raise an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=145.46) [exception at that point, The test is a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=147.22) [simple if statement and a call to raise,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=149.61) [passing the new exception object. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=151.68) [ValueError constructor accepts an error](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=153.7) [message. See how we can modify the doc](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=155.4) [string to make it plain which exception](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=158.55) [type will be raised by square root and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=160.14) [under what circumstances. But look what](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=161.87) [happens if we run the program. We're still](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=164.63) [getting a traceback and an ungraceful](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=167.26) [program exit. This happens because we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=168.91) [forgot to modify our exception handler to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=171.33) [catch ValueError rather than](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=173.2) [ZeroDivisionError. Let's modify our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=174.68) [calling code to catch the right exception](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=177.84) [class and also assign the caught exception](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=179.45) [object to a named variable so that we can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=181.4) [interrogate it after it has been caught.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=183.77) [In this case, our interrogation is simply](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=186.01) [to print the exception object, which knows](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=188.05) [how to display itself as the message to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=190.22) [standard error. Running the program again,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=192.04) [we can see that our exception is being gracefully handled.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=5&mode=live&start=195.2)

[Exceptions and Protocols](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live)

[Exceptions are part of a function's API,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=1.09) [and more broadly, are part of certain](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=3.51) [protocols. For example, objects which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=5.21) [implement the sequence protocol should](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=8.62) [raise an IndexError exception for indices](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=10.31) [which are out of range. The exceptions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=12.71) [which are raised are as much a part of a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=15.33) [function's specification as the arguments](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=16.89) [it accepts, and as such, must be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=18.68) [implemented and documented appropriately.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=20.61) [There are a handful of common exception](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=23.77) [types in Python, and usually, when you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=25.44) [need to raise an exception in your own](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=27.21) [code, one of the built‑in types is a good](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=28.64) [choice. Much more rarely, you'll need to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=30.62) [define a new exception type, but we don't](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=33.09) [cover that in this course. Often, if](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=35.32) [you're deciding what exceptions your code](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=38.2) [should raise, you should look for similar](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=39.7) [cases in existing code. The more your code](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=41.39) [follows existing patterns, the easier it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=43.85) [will be for people to integrate and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=45.83) [understand. For example, suppose you were](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=47.2) [writing a key value database. It would be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=50.22) [natural to use KeyError to indicate a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=52.59) [request for a non‑existent key because](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=54.58) [this is how dict works, that is mapping in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=56.76) [Python follows certain patterns, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=59.58) [exceptions are part of that pattern. Let's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=61.22) [look at a few common exception types.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=64.86) [IndexError is raised when an integer index](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=68.64) [is out of range. You can see this when you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=70.74) [index past the end of the list. ValueError](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=73.58) [is raised when an object is of the right](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=78.11) [type, but contains an inappropriate value.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=79.68) [We've seen that already when trying to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=83.04) [construct an int from a non‑numeric](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=84.66) [string. KeyError is raised when a lookup](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=86.33) [in a mapping fails. You can see that here](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=90.48) [when we look up a non‑existent key in a dict.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=6&mode=live&start=93.7)

[Avoid Explicit Type Checks](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=7&mode=live)

[We tend not to protect against type errors](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=7&mode=live&start=1.1) [in Python. To do so runs against the grain](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=7&mode=live&start=3.17) [of dynamic typing in Python and limits the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=7&mode=live&start=5.72) [reuse potential of code we write. For](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=7&mode=live&start=7.63) [example, our convert function could test](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=7&mode=live&start=10.17) [whether the argument was a list using the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=7&mode=live&start=12.3) [built‑in isinstance function and raise a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=7&mode=live&start=13.96) [type error exception if it was not. But](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=7&mode=live&start=16.32) [then we'd also want to allow arguments](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=7&mode=live&start=19.3) [that are instances of tuple as well. It](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=7&mode=live&start=21) [soon gets complicated if we want to check](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=7&mode=live&start=23.17) [whether our function will work with types](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=7&mode=live&start=25.03) [such as set, dict, or any other iterable](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=7&mode=live&start=26.55) [type. And in any case, who is to say that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=7&mode=live&start=28.9) [it does? Alternatively, as we currently](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=7&mode=live&start=31.28) [do, we could intercept TypeError inside](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=7&mode=live&start=34.44) [our convert function and reraise it, but](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=7&mode=live&start=36.53) [to what end? Usually in Python, it's not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=7&mode=live&start=38.65) [worth adding type checking to your](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=7&mode=live&start=42.29) [functions. If a function works with a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=7&mode=live&start=43.57) [particular type, even one that you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=7&mode=live&start=45.5) [couldn't have known about when you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=7&mode=live&start=47.33) [designed the function, then that's all to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=7&mode=live&start=48.43) [the good. If not, execution will probably](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=7&mode=live&start=50.42) [result in a TypeError anyway. Likewise, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=7&mode=live&start=53.17) [tend not to catch TypeErrors very frequently.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=7&mode=live&start=55.93)

[It's Easier to Ask Forgiveness Than Permission](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live)

[Now let's look at another tenant of Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=1.29) [philosophy and culture, the idea that it's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=3.08) [easier to ask forgiveness than permission.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=5.36) [There are only two approaches to dealing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=8.81) [with a program operation that might fail.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=10.46) [The first approach is to check that all](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=12.65) [the preconditions for a failure‑prone](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=14.3) [operation are met in advance of attempting](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=15.94) [the operation. The second approach is to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=17.86) [blindly hope for the best, but be prepared](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=20.73) [to deal with the consequences if it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=22.91) [doesn't work out. In Python culture, these](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=24.17) [two philosophies are known as look before](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=27.77) [you leap, or LBYL, and it's easier to ask](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=29.67) [forgiveness than permission, EAFP, a term,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=33.23) [which, incidentally, was coined by rear](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=35.88) [admiral Grace Hopper, inventor of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=37.62) [compiler. Python is strongly in favor of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=39.24) [EAFP because it puts primary logic for the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=42.51) [happy path in its most readable form with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=45.01) [deviations from the normal flow handled](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=47.31) [separately rather than interspersed with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=49.07) [the main flow. Let's consider an example,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=50.79) [processing a file. The details of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=54.84) [processing aren't relevant. All we need to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=57.16) [know is that the process\_file function](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=59.28) [will open a file and read some data from](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=61.25) [it. First, the LBYL version. Before](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=63.1) [attempting to call process\_file, we check](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=67.53) [that the file exists, and if it doesn't,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=69.62) [we avoid making the call and print a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=71.55) [helpful message instead. There are several](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=73.27) [problems with this approach, some obvious](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=76.65) [and some insidious. One obvious problem is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=78.62) [that we only perform an existence check.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=81.32) [What if the file exists, but contains](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=83.59) [garbage? What if the path refers to a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=85.34) [directory instead of a file? According to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=87.54) [LBYL, we should add preemptive tests for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=89.78) [these too. A more subtle problem is there](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=92.09) [is a race condition here. It's possible](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=95.36) [for the file to be deleted, for example,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=97.81) [by another process between the existence](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=99.62) [check and the process\_file call, a classic](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=101.91) [issue of atomicity. There's really no good](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=104.22) [way to deal with this. Handling of errors](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=106.77) [from process\_file will be needed in any](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=108.72) [case. Now consider the alternative using](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=110.51) [the more Pythonic EAFP approach. Here, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=114.79) [simply attempt the operation without](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=118.11) [checks in advance, but we have an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=119.81) [exception handler in place to deal with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=121.44) [any problems. We don't even need to know](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=123.1) [in a lot of detail exactly what might go](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=125.56) [wrong. Here we catch OSError, which covers](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=127.43) [all manner of conditions such as file not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=129.91) [found and using directories where files](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=132.08) [are expected. EAFP is standard in Python,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=133.95) [and that philosophy is enabled by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=137.94) [exceptions. Without exceptions, that is,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=139.41) [using error codes instead, you're forced](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=141.85) [to include error handling directly in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=144.16) [main flow of your logic. Since exceptions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=145.99) [interrupt the main flow, they allow you to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=149.42) [handle exceptional cases non‑locally.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=151.2) [Exceptions coupled with EAFP are also](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=153.54) [superior because, unlike error codes,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=155.67) [exceptions cannot be easily ignored. By](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=157.88) [default, exceptions have a big effect,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=161.08) [whereas error codes are silent by default.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=163) [So the exception EAFP‑based style makes it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=165.84) [very difficult for problems to be silently ignored.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=8&mode=live&start=168.3)

[Cleanup Actions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live)

[Sometimes you need to perform a cleanup](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=1.07) [action, irrespective of whether an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=2.97) [operation succeeds. In a later module,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=4.54) [we'll introduce context managers, which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=7.05) [are the modern solution to this common](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=8.82) [situation, but here we'll introduce the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=10.31) [try finally construct, since creating a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=12.55) [context manager can be overkill in simple](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=14.86) [cases. And in any case, an understanding](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=16.86) [of try finally is useful for making your](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=19.74) [own context managers. Consider this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=21.75) [function, which uses various facilities of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=25.8) [the standard OS module to change the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=27.73) [current working directory, create a new](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=29.67) [directory at that location, and then](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=31.47) [restore it to the original working](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=33.41) [directory. At first sight, this seems](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=34.67) [reasonable, but should the call to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=37.36) [os.mkdir fail for some reason, the current](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=39.2) [working directory of the Python process](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=41.66) [won't be restored to its original value,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=43.34) [and the make\_at function will have an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=45.61) [unintended side effect. To fix this, we'd](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=47.48) [like the function to restore the original](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=50.91) [current working directory under all](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=52.56) [circumstances. We can achieve this with a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=54.07) [try finally block. Code in the finally](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=56.75) [block is executed whether exception leaves](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=59.68) [the try block normally by reaching the end](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=61.64) [of the block, or exceptionally by an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=63.46) [exception being raised. This construct can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=65.05) [be combined with except blocks, here used](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=67.84) [to add a simple failure logging facility.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=69.72) [Now, if os.mkdir raises an OS error, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=72.58) [OS error handler will be run, and the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=75.41) [exception will be re‑raised, but since the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=77.12) [finally block is always run, no matter how](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=80.15) [the try block ends, we can be sure that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=82.24) [the final directory change will take place](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=84.29) [in all circumstances. Errors should never](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=86.03) [pass silently, unless explicitly silenced.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=93.01) [Errors are like bells, and if we make them silent, they are of no use.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=9&mode=live&start=95.885)

[Platform-Specific Code](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live)

[Detecting a single key press from Python,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=1.14) [such as the 'press any key to continue'](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=3.37) [functionality at the console, requires use](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=5.32) [of operating system specific modules. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=7.7) [can't use the built‑in input function,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=11.44) [because that waits for the user to press](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=13.3) [Return before giving us a string. To](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=14.85) [implement this, on Windows we need to use](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=17.56) [functionality from the Windows only msvcrt](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=19.32) [module, and on Linux and Mac OS X, we need](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=22.27) [to use functionality from the Unix only](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=25.21) [tty and termios modules, in addition to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=27.79125) [the sys module. This example is quite](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=30.37) [instructive, as it demonstrates many](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=33.57) [Python language features including import](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=35.33) [and def as statements, as opposed to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=37.34) [declarations. Recall, The top‑level module](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=39.31) [code is executed on first import. Within](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=42.42) [the first try block, we attempt to import](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=45.21) [msvcrt, the Microsoft Visual C Runtime. If](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=47.38) [this succeeds, we then proceed to define a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=51.29) [function, getkey, which delegates to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=53.34) [msvcert getch function. Even though we're](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=55.49) [inside a try block at this point, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=59.17) [function will be declared at the current](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=61.09) [scope, which is the module scope. If,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=62.55) [however, the import of msvcrt fails](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=66.08) [because we're not running on Windows, an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=68.63) [import error will be raised, and execution](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=70.93) [will transfer to the except block. This is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=72.67) [a case of an error being silenced](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=75.41) [explicitly because we're going to attempt](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=76.94) [an alternative course of action in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=78.93) [exception handler. Within the except](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=80.37) [block, we import three modules needed for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=83.37) [a getkey implementation on Unix‑like](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=85.37) [systems, and then proceed to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=87.32) [alternative definition of getkey, which,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=89.12) [again, binds the function implementation](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=91.12) [to a name in the module scope. This Unix](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=93) [implementation of getkey uses a try](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=96.92) [finally construct to restore various](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=99.12) [terminal attributes after the terminal has](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=101.22) [been put into raw mode for the purposes of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=103.14) [reading a single character. In the event](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=105.11) [that our program is running on neither](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=107.98) [Windows nor a Unix‑like system, the import](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=109.44) [tty statement will raise a second import](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=112.01) [error. This time we make no attempt to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=114.17) [intercept the exception. We allow it to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=116.84) [propagate to our caller, which is whatever](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=118.92) [attempted to import this key press module.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=120.92) [We know how to signal this error, but not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=123.71) [how to handle it, so we defer that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=125.46) [decision to our caller. The error will not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=127.17) [pass silently. If the caller has more](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=129.51) [knowledge or alternative tactics](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=132.26) [available, it can in turn intercept this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=133.73) [exception and take appropriate action,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=135.73) [perhaps degrading to using Python's input](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=137.66) [built‑in function and giving a different message to the user.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=10&mode=live&start=139.74)

[Summary](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live)

[Exceptions are an essential topic in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=1.19) [Python, and it's critical that you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=3.06) [understand how to work with them as you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=4.45) [develop your mastery of the language. In](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=6.01) [this module, we learned that the raising](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=8.22) [of an exception interrupts normal program](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=10.35) [flow and transfers control to an exception](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=12.29) [handler. Exception handlers are defined](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=14.555) [using the try except construct. Try blocks](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=17.56) [define a context in which exceptions can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=21.335) [be detected. Corresponding except blocks](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=23.36) [define handlers for specific types of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=26.73) [exceptions. Python uses exceptions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=28.55) [pervasively, and many built‑in language](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=31.95) [features depend on them. Except blocks can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=33.9) [capture an exception object, which is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=37.04) [often of a standard type such as value](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=38.66) [error, key error, or index error.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=40.69) [Programmer errors, such as indentation](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=43.74) [error and syntax error, should not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=45.55) [normally be handled. Exceptional](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=47.2) [conditions can be signaled using the raise](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=49.98) [keyword, which accepts a single parameter](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=51.97) [of an exception object. Raise without an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=54.14) [argument within an except block re‑raises](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=57.35) [the exception which is currently being](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=59.39) [processed. We tend not to routinely check](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=60.86) [for type errors. To do so would negate the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=64.37) [flexibility afforded to us by Python's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=66.54) [dynamic type system. Exception objects can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=68.35) [be converted to strings using the str](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=71.54) [constructor for the purposes of printing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=73.47) [message payloads. The exceptions thrown by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=75.32) [a function form part of its API and should](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=78.68) [be appropriately documented. When raising](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=80.92) [exceptions, prefer to use the most](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=84.13) [appropriate built‑in exception type.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=85.82) [Cleanup and restorative actions can be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=88.64) [performed using the try finally construct,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=90.44) [which may optionally be used in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=92.91) [conjunction with except blocks. Along the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=94.31) [way, we saw that the output of the print](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=97.36) [function can be redirected to standard](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=99.89) [error using the optional file argument.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=101.64) [The expressions in f strings can be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=104.92) [suffixed with !r to use the repr](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=106.47) [representation of the inserted value.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=108.89) [Python supports the logical operators and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=112) [an or for combining Boolean expressions.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=114.32) [Return codes are too easily ignored.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=117.87) [Platform‑specific actions can be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=121.14) [implemented using an easier to ask](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=122.83) [forgiveness than permission approach](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=124.74) [facilitated by intercepting import errors](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=126.18) [and providing alternative implementations.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=128.52) [In the next module of Core Python: Getting](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=131.54) [Started, we'll take a deeper look at the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=133.36) [concept of iteration in Python, covering](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=135.09) [topics including comprehensions, Python's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=137.1) [iteration protocols, and lazy evaluation.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=139.4) [Thanks for watching, and we'll see you in the next module.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=45d65dfc-ed2a-4ce7-8b82-ea26ebc7b6af&clip=11&mode=live&start=142.44)

[Iteration and Iterables](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live)

[Overview](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live)

[A central abstraction in Python is the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=1.31) [notion of an iterable, an object from](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=3.03) [which you can fetch a sequence of other](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=4.95) [objects. The act of fetching a sequence](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=6.33) [from an iterable is known as iteration,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=8.71) [and you've already encountered it many](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=10.61) [times in the form of the for loop.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=12.13) [Iteration in Python is designed to be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=14.405000000000001) [simple to use and not require a deep](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=16.56) [understanding on the part of the user. But](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=18.46) [under this fairly unassuming surface lies](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=20.6) [a sophisticated and powerful system. In](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=22.53) [this module of Core Python: Getting](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=25.08) [Started, we'll look at comprehensions,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=26.49) [Python's shorthand syntax for creating](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=28.67) [certain kinds of iterable objects. We'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=30.55) [see that some comprehensions create](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=32.65) [objects that you're already familiar with,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=34.02) [like lists and sets, while others create](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=35.75) [wholly new kinds of objects with some](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=38.4) [surprising properties. We'll learn about](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=40.04) [the syntax for filtering in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=42.23) [comprehensions. We'll discover Python's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=43.754999999999995) [low‑level API for working with iterable](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=45.76) [objects, and in doing so, we'll learned](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=47.74) [about another crucial element of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=50.29) [iteration, the concept of the iterator.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=51.61) [We'll also look into Python's somewhat](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=54.44) [surprising use of exceptions in its core](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=55.86) [iteration protocol. We'll cover generator](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=57.82) [functions, a powerful and sometimes subtle](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=60.4) [technique for defining iterable sequences](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=62.57) [as computations. In doing so, we'll talk](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=64.53) [about Python's yield keyword, and we'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=67.14) [look at some fascinating qualities of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=69.37) [generators, such as statefulness,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=70.81) [laziness, and the ability to model](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=72.5) [infinite sequences. We'll also cover what](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=74.12) [are known as generator expressions, a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=76.91) [cross between comprehensions and generator](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=78.62) [functions. Finally, we'll look at some of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=80.49) [the tools that Python provides for working](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=82.79) [with iteration, including several elements](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=84.43) [from the standard library's itertools](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=86.29) [module. Let's jump right into comprehensions.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=0&mode=live&start=87.95)

[List and Set Comprehensions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live)

[Comprehensions in Python are concise](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=1.04) [syntax for describing lists, sets, or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=2.81) [dictionaries in a declarative or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=4.95) [functional style. This shorthand is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=6.54) [readable and expressive, meaning that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=8.73) [comprehensions are very effective at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=10.34) [communicating intent to human readers.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=11.99) [Some comprehensions almost read like](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=14.5) [natural language, making them nicely](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=16.02) [self‑documenting. Comprehensions are much](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=17.72) [easier to demonstrate than they are to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=21.82) [explain, so let's bring up a Python REPL.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=23.18) [First, we'll create a list of words by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=25.405) [splitting a string. Now comes a list](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=27.3125) [comprehension. The comprehension is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=30.22) [enclosed in square brackets, just like a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=32.42) [literal list, but instead of literal](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=34.78) [elements, it contains a fragment of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=35.64) [declarative code, len(word), which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=37.11) [describes how to construct the elements of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=39.9) [a list, which we loop over using for word](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=41.48) [in words. Here the new list is formed by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=43.62) [binding word to each value in words in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=46.4) [turn and evaluating len(word) to create a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=48.34) [new value. Each of these new values](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=50.76) [becomes an element in the newly](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=53.09) [constructed list. The general form of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=54.23) [list comprehension is an opening square](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=57.53) [bracket, an expression, a statement](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=59.18) [binding a name to successive elements of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=61) [an iterable, and a closing square bracket.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=62.7) [That is, for each item in the iterable on](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=65.095) [the right, we evaluate the expression on](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=67.98) [the left, which is almost always, but not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=69.74) [necessarily in terms of the item, and use](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=71.71) [that as the next element of the list being](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=74.02) [constructed. The comprehension is the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=75.66) [declarative equivalent of the following](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=77.9) [imperative code. We first create the empty](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=79.4) [list lengths. We then use a for loop to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=81.74) [iterate over words, binding each element](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=85.01) [in turn to the name word. For each](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=86.86) [iteration, we calculate the length of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=90.11) [word and append the length to lengths.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=91.16) [Note that the source object over which we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=93.48) [iterate doesn't need to be a list. It can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=95.245) [be any object which implements the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=97.23) [iterable protocol, such as a tuple. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=98.59) [expression producing the new list's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=101.59) [elements can be any Python expression.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=103.02) [Here we find the number of decimal digits](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=105.24) [in each of the first 20 factorials using](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=106.89) [range to generate the source of sequence.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=108.83) [First, we import factorial from the math](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=111.27) [module. We then calculate the length of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=113.18) [the decimal string representation of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=115.55) [factorial of each integer from 0 to 19.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=117.09) [Note also that the type of the object](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=120.61) [produced by list comprehensions is nothing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=122.18) [more or less than a regular list. Set](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=123.86) [supports a similar comprehension syntax](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=127.3) [using, as you might expect, curly braces.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=129.33) [Our number of digits in factorials result](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=132.17000000000002) [contained duplicates. By building a set](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=135.1) [instead, we can eliminate them, although](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=137.32) [note that the resulting set is not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=139.64) [necessarily stored in a meaningful order since sets are unordered containers.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=1&mode=live&start=141.13)

[DIctionary Comprehensions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live)

[The third type of comprehension is the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=1.1) [dictionary comprehension. This also uses](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=2.66) [curly braces and is distinguished from the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=5.73) [set comprehension by the fact that we now](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=7.47) [provide two colon‑separated expressions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=9.17) [for the key and the value, which will be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=11.34) [evaluated in tandem for each new item.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=13.05) [Let's start with the dictionary we can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=16.83) [play with which maps countries to capital](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=18.15) [cities, United Kingdom to London, Brazil](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=19.9) [to Brasilia, Morocco to Rabat, and Sweden](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=22.34) [to Stockholm. One nice use for a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=24.89) [dictionary comprehension is to invert a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=27.15) [dictionary so we can perform efficient](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=28.82) [look‑ups in the opposite direction. Here](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=30.34) [we use capital cities as the keys by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=32.55) [putting capital on the left of the colon](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=34.21) [and countries as the values by putting](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=35.93) [country on the right. We get the country](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=37.47) [capital tuples by looping over country to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=39.62) [capitol.items. We can now import the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=41.49) [pprint function and use it to pretty print](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=44.96) [our new inverted dictionary. Note that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=46.97) [dictionary comprehensions do not operate](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=50.89) [directly on dictionary sources. Well, they](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=52.68) [can, but recall that iterating over a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=54.85) [dictionary yields only the keys. If we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=56.51) [want both keys and values, we should use](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=59.32) [the items method and then tuple unpacking](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=61.08) [to access the key and value separately, as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=63.07) [we did in this example, Should your](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=65.04) [comprehension produce some identical keys,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=67.19) [later keys will overwrite earlier keys. In](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=69.03) [this example, we start with a list of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=71.6) [words and map the first letter of words to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=73.04) [the words themselves, but only the last H](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=75.26) [word is kept. Remember that there's no](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=77.63) [limit to the complexity of the expression](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=81.23) [you can use in any of the comprehensions,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=82.86) [but for the sake of your fellow](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=84.22) [programmers, you should avoid going](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=85.58) [overboard. Extract complex expressions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=87.05) [into separate functions to preserve](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=89.53) [readability. The following is close to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=90.93) [limit of being reasonable for a dictionary](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=94.78) [comprehension. We import OS and glob. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=96.53) [then use a dictionary comprehension to map the real paths of files to their sizes.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=2&mode=live&start=99.92)

[Filtering Comprehensions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live)

[All three types of collection](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live&start=1.04) [comprehensions support an optional](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live&start=2.39) [filtering clause. This clause allows us to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live&start=3.82) [choose which items of the source are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live&start=6.1) [evaluated by the expression on the left.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live&start=7.62) [To make this interesting, we'll first find](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live&start=9.81) [a primality testing predicate function. It](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live&start=12.18) [uses the square root function, so we have](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live&start=15.33) [to import that. We then define the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live&start=17.14) [function is\_prime. It checks to see if the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live&start=19.71) [input is less than 2, returning False if](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live&start=22.38) [so. It then checks if the input can be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live&start=24.53) [evenly divided by any integer up to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live&start=26.77) [square root of the input, returning False,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live&start=28.64) [if so. Finally, it returns True if no](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live&start=30.384999999999998) [divisors were found, We can now use](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live&start=33.75) [is\_prime as the filtering clause of a list](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live&start=36.5) [comprehension to produce all primes less](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live&start=38.42) [than 100. We have a slightly odd‑looking x](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live&start=40.33) [for x construct here because we're not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live&start=43.49) [applying any transformations to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live&start=45.11) [filtered values. The expression in terms](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live&start=46.61) [of x is simply x itself. There's nothing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live&start=48.68) [to stop us combining a filtering predicate](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live&start=52.73) [with a transforming expression. Here's a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live&start=54.42) [dictionary comprehension, which maps](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live&start=56.53) [numbers with exactly three divisors to a tuple of those divisors.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=3&mode=live&start=57.99)

[Moment of Zen](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=4&mode=live)

[Code is written once but read over and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=4&mode=live&start=2.09) [over. Fewer is clearer. Comprehensions are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=4&mode=live&start=4.6) [often more readable than the alternative.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=4&mode=live&start=8.161249999999999) [However, it's possible to overuse](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=4&mode=live&start=10.39) [comprehensions. Sometimes a long or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=4&mode=live&start=12.21) [complex comprehension may be less readable](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=4&mode=live&start=14.49) [than the equivalent for loop. There's no](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=4&mode=live&start=16.51) [hard and fast rule about when one form](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=4&mode=live&start=18.56) [should be preferred. But be conscientious](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=4&mode=live&start=20.32) [when writing your code and try to choose](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=4&mode=live&start=22.3) [the best form for your situation. Above](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=4&mode=live&start=23.94) [all, your comprehensions should ideally be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=4&mode=live&start=26.37) [truly functional. That is, they should](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=4&mode=live&start=28.38) [have no side effects. If you need to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=4&mode=live&start=30.18) [create side effects such as printing to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=4&mode=live&start=32.45) [the console during iteration, use another construct, such as a for loop instead.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=4&mode=live&start=34.1)

[Iteration Protocols](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live)

[Comprehensions and for loops are the most](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=1.71) [frequently used language features for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=2.8) [performing iteration. That is, taking](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=4.26) [items one by one from a source and doing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=6.5) [something with each in turn. However, both](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=8.38) [comprehensions and for loops iterate over](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=10.7) [the whole sequence by default, whereas](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=12.35) [sometimes more fine‑grained control is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=14.08) [needed. There are two important concepts](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=15.86) [here on top of which a great deal of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=18.85) [Python language behavior is constructed,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=19.96) [iterable objects and iterator objects,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=22.14) [both of which are reflected in standard](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=24.54) [Python protocols. The iterable protocol](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=26.11) [allows us to pass an iterable object,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=29.58) [usually a collection or stream of objects,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=31.44) [such as a list, to the built‑in iter](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=33.3) [function to get an iterator for the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=35.04) [iterable object. Iterator objects, in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=36.59) [turn, support the iterator protocol, which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=39.43) [requires that we can pass the iterator](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=41.34) [object to the built‑in next function to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=42.900000000000006) [fetch the next value from the underlying](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=45.04) [collection. As usual, a demonstration at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=46.64) [the Python REPL will help all these](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=50.87) [concepts crystallize into something you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=52.32) [can work with. We use a list of names of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=53.93) [the seasons, in British English no less,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=56.13) [as our iterable source object. We ask our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=57.92) [iterable object to give us an iterator](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=61.12) [using the iter built in and then request a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=62.510000000000005) [value from the iterabor using the next](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=64.94) [built in. Each call to next moves the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=66.85) [iterator through the sequence. But what](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=69.75) [happens when we reach the end? In a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=71.93) [spectacular display of liberalism, Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=73.8) [raises an exception specifically of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=76) [type StopIteration. Those of you coming](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=77.78) [from other programming languages with a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=81.5) [more straightlaced approach to exceptions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=82.84) [may find this mildly outrageous, but I ask](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=84.65) [you, What could be more exceptional than](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=86.96) [reaching the end of a collection? It only](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=88.49) [has one end after all. This attempt at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=90.28) [rationalizing the language design decision](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=93.11) [makes even more sense when one considers](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=94.84) [that the iterable series may be a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=96.46) [potentially infinite stream of data.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=97.69) [Reaching the end in that case really would](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=99.39500000000001) [be something to write home about or,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=101.01) [indeed, raise an exception for. With for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=102.49) [loops and comprehensions at our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=106) [fingertips, the utility of these](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=107.08) [lower‑level iteration protocols may not be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=108.67) [obvious. To demonstrate a more concrete](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=110.63) [use, here's a little utility function,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=113.42) [which, when passed an iterable object,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=114.81) [returns the first item in that series or,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=116.55) [if the series is empty, raises a value](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=118.7) [error. First, it calls iter on the input](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=120.57) [interable object to produce an iterator.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=123.45) [It then calls next on the iterator inside](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=125.55375000000001) [a try block returning the results. If the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=128.15) [input iterable is empty, the next has no](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=130.49) [value to return, and it instead raises](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=132.58) [StopIteration. We catch that and raise a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=134.48) [value error instead. This function works](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=137.42) [as expected on any iterable object. Here](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=141) [we see it getting the first element from a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=143.31) [list, and we can see it doing the same for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=144.76) [set. If we pass an empty set to first, it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=147.77) [throws a value error. It's worth noting](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=151.06) [that the higher‑level iteration](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=153.5) [constructs, such as for loops and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=154.745) [comprehensions, are built directly upon this lower‑level iteration protocol.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=5&mode=live&start=156.18)

[Generator Functions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live)

[Now we come to generator functions, one of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=1.14) [the most powerful and elegant features of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=3.15) [the Python programming language. Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=4.81) [generators provide the means for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=7.62) [describing iterable series with code in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=8.87) [functions. These sequences are evaluated](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=10.78) [lazily, meaning they only compute the next](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=13.5) [value on demand. This important property](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=15.52) [allows them to model infinite sequences of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=18) [values with no definite end, such a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=19.76) [streams of data from a sensor or active](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=21.53) [log files. By carefully designing our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=23.34) [generator function, we can make generic](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=26.15) [stream processing elements, which can be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=27.8) [composed into sophisticated pipelines.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=29.31) [Generators are defined by any Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=32.92) [function which uses the yield keyword at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=34.97) [least once in its definition, they may](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=36.67) [also contain the return keyword with no](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=38.73) [arguments. And just like any other](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=40.5) [function, there is an implicit return at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=42.4) [the end of the definition. To understand](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=44.05) [what generators do, let's start with a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=46.89) [simple example at the python ripple. Let's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=48.63) [define the generator, and then we'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=50.78) [examine how the generator works. Generator](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=52.23) [functions are introduced by def just as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=55.22) [for a regular Python function. We'll then](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=57.25) [yield the values 1, 2, and 3 in order. Now](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=60) [let's call gen123 and assign its return](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=63.78) [value to g. As you can see, gen123 is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=66.01) [called just like any other Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=69.47999999999999) [function, but what has it returned? G is a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=71.34) [generator object. Generators are, in fact,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=73.62) [Python iterators so we can use the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=76.5) [iterated protocol to retrieve or yield](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=78.03) [successive values from the series. Take](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=80.26) [note of what happens now that we've](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=83.1) [yielded the last value from our generator.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=84.22) [Subsequent calls to next raise a stop](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=86.49) [iteration exception just like any other](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=88.32) [Python iterator. Because generators are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=90.34) [iterators and because iterators must also](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=93.43) [be iterable, they can also be used in all](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=94.75) [the usual Python constructs which expect](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=96.91) [iterable objects, such as for loops. Be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=98.71) [aware that each call to the generator](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=101.22) [function returns a new generator object.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=102.62) [Here recall a generator function two times](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=105.18) [binding the results to h and i,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=107.09) [respectively. If we look at h and i, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=108.71) [see that they're different objects and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=111.5) [that each generator object can be advanced](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=112.99) [independently. Let's take a closer look at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=114.76) [how and crucially when the code in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=117.12) [body of our generator function is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=119.23) [executed. To do this, we'll create a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=120.44) [slightly more complex generator that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=122.66) [traces its execution with good old](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=124.33) [fashioned print statements. We'll call](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=125.79) [this generator gen246. It will first print](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=127.69) [that it's about to yield 2 and then it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=131) [will yield 2, it will do the same for 4](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=132.79) [and finally for 6. At the end, it will](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=136.25) [print that it's about to return. Now we'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=140.16) [call the generator and assign it to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=143.18) [name g. At this point, the generator](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=144.69) [object has been created and returned, but](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=147.04) [none of the code within the body of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=148.84) [generator function has yet been executed,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=150.09) [so let's fetch the first value from the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=152.385) [generator. See how when we request the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=154.12) [first value, the generator body runs up to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=156.14) [and including the first yield statement,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=158.34) [the code executes just far enough to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=160.38) [literally yield the next value. When we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=162.04) [request the next value from the generator,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=165) [execution of the generator function](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=166.76) [resumes at the point it left off and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=168.3) [continues running until the next yield.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=170.07) [After the final value has returned, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=172.2) [next request causes the generator function](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=173.87) [to execute until it returns at the end of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=175.6) [the function body, which in turn raises](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=177.39) [the expected StopIteration exception. Now](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=179.25) [that we've seen how generator execution is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=182.17) [initiated by calls to next and interrupted](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=183.78) [by yield statements, we could progress to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=185.69) [placing more complex code in a generator function body.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=6&mode=live&start=187.35)

[Maintaining State in Generators](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live)

[Now, we'll look at how our generator](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=1.19) [functions, which resumes execution each](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=2.61) [time the next value is requested can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=4.41) [maintain state in local variables. In the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=6.03) [process of doing so, our generators will](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=8.71) [be both more interesting and more useful.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=10.53) [The resumable nature of generator](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=13.19) [functions can result in complex control](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=14.57) [flow, so we'll be watching the execution](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=16.29) [of these generators in a graphical Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=18.2) [debugger. I'll be using PyCharm, but you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=19.88) [can use any Python debugger to trace](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=22.71) [generator execution. We'll be showing two](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=24.32) [generators which demonstrate lazy](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=28.85) [evaluation, which we'll then combine into](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=29.71) [a generator pipeline. The first generator](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=31.7) [we'll look at is take, which retrieves a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=34.08) [specified number of elements from the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=35.82) [front of an iterable. Note that the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=37.3) [function defines a generator because it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=39.35) [contains at least one yield statement.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=40.86) [This particular generator also contains a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=43.07) [return statement to terminate the stream](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=44.87) [of yielded values. The generator simply](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=46.5) [uses a counter to keep track of how many](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=48.8) [elements have been yielded so far, ending](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=50.41) [the sequence when we reach a specified](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=52.47) [point. Now, let's bring our second](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=53.96) [generator into the picture. This generator](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=57.75) [function, called distinct, eliminates](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=59.72) [duplicate items by keeping track of which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=61.67) [elements it's already seen in a set. In](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=63.34) [this generator we also make use of a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=66.41) [control flow construct we have not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=67.85) [previously seen, the continue keyword. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=69.22) [continue statement finishes the current](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=71.88) [iteration of the loop and begins the next](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=73.45) [iteration immediately. When executed in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=75.08) [this case, execution will be transferred](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=77.64) [back to the for statement, but as with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=79.45) [break, it can also be used with while](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=81.09) [loops. In this case, that continue is used](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=82.73) [to skip any values which have already been](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=85) [yielded. Now we'll arrange both of our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=86.74) [generators into a lazy pipeline using take](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=90.45) [and distinct together to fetch the first](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=92.79) [three unique items from a collection. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=94.4625) [start by creating a small list called](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=96.8) [items. We pass the result of distinct into](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=98.49) [take and loop over the results. Notice](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=101.18) [that the distinct generator only does just](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=103.9) [enough work to satisfy the demands of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=105.82) [take generator, which it is iterating](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=107.47) [over. It never gets as far as the last two](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=109) [items in the source list because they are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=111.67) [not needed to produce the first three](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=113.12) [unique items. This lazy approach to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=114.85125) [computation is very powerful, but the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=117.47) [complex control flows it results in can be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=119.2) [difficult to debug. It's often useful](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=120.99) [during development to force evaluation of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=123.13) [all the generated values, and this is most](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=124.92) [easily achieved by inserting a call to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=126.76) [list constructor. This interspersed call](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=128.66) [to list causes the distinct generator to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=131.065) [exhaustively process its source items before take does its work.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=7&mode=live&start=133.04)

[Laziness and the Infinite](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live)

[Generators are lazy, meaning that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=1.04) [computation only happens just in time when](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=2.59) [the next result is requested. This](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=4.78) [interesting and useful property of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=6.56) [generators means that they can be used to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=7.84) [model infinite sequences, since values are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=9.21) [only produced as requested by the caller,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=11.73) [and since no data structure needs to be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=13.45) [built to contain the elements of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=15.04) [sequence, generators can safely be used to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=16.36) [produce never‑ending or just very large](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=18.6) [sequences like sensor readings,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=20.47) [mathematical sequences, and the contents](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=22.46) [of multi‑terabyte files. The authors of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=24.55) [this course are sworn by sacred oath never](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=28.52) [to use either Fibonacci or quicksort](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=30.49) [implementations in demonstrations or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=32.11) [exercises. Allow us instead to present a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=33.7) [generator function for the Lucas series,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=36.17) [which has nothing whatsoever to do with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=38.26) [the order in which you should watch the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=39.74) [episodes of Star Wars. The Lucas series](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=40.85) [starts with 2, 1 and each value after that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=43.56) [is the sum of the two proceeding values.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=46.31) [So the first few values of the sequence](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=48.64) [are 2, 1, 3, 4, 7, and 11. The first yield](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=50.26) [produces the value 2. The function then](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=54.75) [initializes A and B, which hold the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=56.91) [previous two values needed as the function](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=58.6) [proceeds. Then the function enters an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=60.61) [infinite while loop, where it yields the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=62.62) [value of B. A and B are updated to hold](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=64.61) [the new previous two values using a neat](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=67.25) [application of tuple unpacking. Now that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=69.68) [we have a generator, it can be used like](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=72.38) [any other iterable object. For instance,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=74) [to print the Lucas numbers, you could use](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=76.41) [a loop like this. Of course, since the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=77.84) [Lucas sequence is infinite, this will run](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=80.33) [forever, printing out values until your](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=82.04) [computer runs out of memory. Use Ctrl+C to terminate the loop.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=8&mode=live&start=83.8)

[Generator Expressions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live)

[Generator expressions are a cross between](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=1.14) [comprehensions and generator functions.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=3.1) [They use a similar syntax as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=5.4) [comprehensions, but they result in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=6.68) [creation of a generator object, which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=8.25) [produces the specified sequence lazily.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=9.83) [The syntax for generator expressions is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=13.1) [very similar to list comprehensions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=14.74) [delimited by parentheses instead of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=16.35) [brackets used for list comprehensions.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=18.1) [Generator expressions are useful for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=19.76) [situations where you want the lazy](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=23.49) [evaluation of generators with the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=24.89) [declarative concision of comprehensions.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=26.37) [For example, this generator expression](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=28.59) [yields a list of the first 1 million](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=30.53) [square numbers. At this point, none of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=32.07) [squares have been created, we just](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=35.07) [captured the specification of the sequence](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=36.42) [into a generator object. We can force](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=38.1) [evaluation of the generator by using it to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=41.04) [create a long list. This list obviously](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=42.985) [consumes a significant chunk of memory, in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=46.22) [this case, about 40 MB for the list object](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=48.68) [and the integer objects contained therein.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=50.92) [Also, notice that a generator object is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=53.21) [just an iterator, and once run](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=55.545) [exhaustively in this way, will yield no](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=57.29) [more items. Repeating the previous](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=59.19) [statement returns an empty list.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=61.06) [Generators are single use objects. Each](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=63.44) [time we call a generator function, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=65.53) [create a new generator object. To recreate](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=67.05) [a generator from a generator expression,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=69.63) [we must execute the expression itself once](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=71.41) [more. Let's raise the stakes by computing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=73.31) [the sum of the first 10 million squares](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=76.61) [using the built‑in some function, which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=78.42) [accepts an iterable series of numbers. If](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=80.06) [this were a list comprehension, we could](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=82.58) [expect this to consume around 400 MB of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=84.08) [memory. Using a generator expression,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=86.29) [memory usage will be insignificant. This](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=88.6) [produces a result in a second or so and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=91.59) [uses almost no memory. Looking carefully,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=93.47) [you could see that, in this case, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=96.73) [didn't supply separate enclosing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=98.01) [parentheses for the generator expression,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=99.44) [in addition to those needed for this sum](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=101.07) [function call. This elegant ability to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=102.91999999999999) [have the parenthesis used for the function](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=105.31) [call also serve for the generator](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=106.93) [expression aides readability. You could](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=108.5) [include the second set of parentheses if](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=110.78) [you wish. As with comprehensions, you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=112.45) [could include an IF clause in the end of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=116.465) [the generator expression. Reusing our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=117.98) [admittedly inefficient is\_prime predicate,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=120.73) [we can determine the sum of those integers](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=122.69) [for the first 1,000 which are prime like](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=124.14) [this. Note that this is not the same thing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=126.61) [as computing the sum of the first 1,000](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=128.86) [primes, which is a more awkward question](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=130.68) [because we don't know in advance how many](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=132.34) [integers we need to test before we clock up 1,000 primes.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=9&mode=live&start=133.81)

[Iteration Tools](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live)

[So far, we've covered the many ways Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=1.04) [offers for creating iterable objects.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=2.88) [Comprehensions, generators, and any object](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=4.9) [which follows the iterable or iterator](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=7.02) [protocols can be used for iteration, so it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=8.54) [should be clear that iteration is a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=10.79) [central feature of Python. Python provides](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=12.06) [a number of built‑in functions for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=14.91) [performing common iterator operations.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=16.22) [These functions form the core of a sort of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=18.52) [vocabulary for working with iterators, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=20.17) [they can be combined to produce powerful](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=22.34) [statements in very concise, readable code.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=23.86) [We've met some of these functions already,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=26.94) [including enumerate for producing integer](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=28.48) [indices and sum for computing summation of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=30.24) [numbers. In addition to the built‑in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=32.41) [functions, the itertools module contains a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=34.56) [wealth of useful functions and generators](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=36.52) [for processing iterable streams of data.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=38.27) [We'll start demonstrating these functions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=40.63) [by solving the first 1,000 primes problem](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=42.2) [using the built‑in sum with two generator](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=44.07) [functions from intertools, islice and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=46.18) [count. Earlier, we made our own take](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=48.24) [generator function for lazily retrieving](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=51.14) [the start of the sequence. We needn't have](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=53.01) [bothered, however, because islice allows](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=55.2) [us to perform lazy slicing similar to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=57.05) [built‑in list slicing functionality. To](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=59) [get the first 1,000 primes, we need to do](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=61.75) [something like islice(all\_primes, 1000).](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=63.63) [But how to generate all primes?](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=67.94) [Previously, we've been using range to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=70) [create the raw sequences of integers to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=71.73) [feed into our primality test, but ranges](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=73.36) [must also be finite, that is bounded on](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=75.6) [both ends. What we'd like is an open‑ended](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=77.69) [version of range, and that is exactly what](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=80.15) [itertools count provides. Using count and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=81.93) [islice, our first 1,000 primes expression](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=85.69) [can be written out as the islice of a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=87.79) [generator of all prime numbers. This](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=89.5) [returns a special islice object which is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=92.68) [iterable. We can convert it to a list](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=94.69) [using the list constructor. Answering our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=97.06) [question about the sum of the first 1,000](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=99.73) [primes is now easy, remembering to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=101.50249999999998) [recreate the generators. We simply pass](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=103.18) [that islice we just defined to the sum](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=105.17) [function. Two other very useful built‑ins](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=107.3) [which facilitate elegant programs, are any](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=111.3) [and all. They are equivalent to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=113.35) [logical operators 'and' and 'or', but for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=115.13) [iterable series of bool values. Any takes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=117.39) [an iterable and tells you if any elements](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=120.5) [in it are true. All takes an iterable and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=122.25) [tells you if all the elements in it are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=124.78) [true. Here we'll use any together with a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=126.21) [generator expression to answer the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=128.96) [question of whether there are any prime](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=130.41) [numbers in the range 1328 to 1360,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=131.91) [inclusive. Any is prime of X for X in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=135.89) [range 1323 to 1361. For a completely](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=139.14) [different type of problem, we can check](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=145.09) [that all of these city names are proper](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=146.68) [nouns with initial uppercase letters. All](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=148.2) [of name equals name.title for each name in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=150.66) [a list of cities. The last built‑in we'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=153.23) [look at is zip, which, as its name](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=157.02) [suggests, gives us a way to synchronize](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=158.73) [iteration over two iterable series. For](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=160.55) [example, let's define a column of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=163.52) [temperatures for sunday and a column for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=165.11) [monday. If we zip these together, we can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=167.97) [see that zip yields tuples when iterated.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=171.15) [This, in turn, means we can use it with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=174.04) [tuple unpacking in the for loop. In fact,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=175.51) [zip can accept any number of iterable](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=178.64) [arguments. Let's add a third time series.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=180.37) [We then zip together sunday, monday, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=183.54) [tuesday, and use min, max, sum, and len to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=185.41) [calculate some statistics for our data](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=188.59) [points. Note how we've used string](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=190.13) [formatting features to control the numeric](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=193.23) [column width to four characters. Perhaps](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=194.93) [though, we'd like one long temperature](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=197.45) [series for sunday, monday, and tuesday. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=198.93) [can lazily concatenate iterables using](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=201.32) [itertools.chain, so this is different from](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=203.22) [simply concatenating three lists into a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=205.29) [new list. We can now check that all of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=207.24) [those temperatures are above freezing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=209.9) [point without the memory impact of data](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=211.33) [duplication. Before we summarize, we'd](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=213.15) [like to pull a few pieces of what we've](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=217.11) [made together and leave your computer](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=218.44) [computing the Lucas primes. When you've](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=219.89) [seen enough, we recommend you spend some time exploring the itertools module.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=10&mode=live&start=223.14)

[Summary](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live)

[Iteration is a pervasive and powerful](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=1.14) [concept in Python. Having a good](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=2.92) [understanding of how to work with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=4.6) [iterables and iteration is often the key](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=5.665) [to designing elegant, sophisticated](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=7.34) [solutions to your problems. In this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=8.95) [module, we learned that comprehensions are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=11.1) [a concise syntax for describing lists,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=13.1025) [sets, and dictionaries. Comprehensions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=15.28) [operate on a iterable source objects and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=18.42) [apply an optional predicate filter and a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=20.1) [mandatory expression, both of which are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=21.98) [usually in terms of the current item.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=23.9) [Iterable objects are objects for which we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=26.145) [can iterate item by item. We retrieve an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=28.43) [iterator from an iterable object using the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=31.4725) [built‑in iter function. Iterators produce](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=33.34) [items one by one from the underlying](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=36.45) [iterable series each time they are passed](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=38.32) [to the built‑in next function. Iterators](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=40.09) [raise a StopIteration exception when the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=43.25) [collection is exhausted. Generator](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=44.82) [functions allow us to describe sequences](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=47.46) [using imperative code. Generator functions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=49.18) [contain at least one use of the yield](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=52.29) [keyword. Generators are iterators. When](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=54.14) [the iterator is advanced with next, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=57.62) [generator starts or resumes execution up](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=59.42) [to and including the next yield. Each call](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=61.63) [to a generator function creates a new](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=64.78) [generator object. Generators can maintain](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=66.23) [explicit state and local variables between](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=69.3) [iterations. Generators are lazy and so can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=71.34) [model infinite series of data. Generator](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=74.8) [expressions have a similar syntactic form](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=77.89) [to list comprehensions and allow for a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=79.61) [more declarative and concise way of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=81.395) [creating generator objects. Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=82.94) [includes a rich set of tools for dealing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=85.77) [with iterable series, both in the form of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=87.4) [built‑in functions such as sum, any, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=89.43) [zip, but also in the iterables module. In](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=91.67) [the next module of Core Python: Getting](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=96.43) [Started, we'll look a topic that you might](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=97.94) [have expected to see earlier in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=99.69) [course, that of classes. Classes allow you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=101) [to define the structure and behavior of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=103.78) [objects in a unified manner, and Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=105.45) [has strong support for defining them.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=107.5) [Thanks for watching, and we'll see you in the next module.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=1403cc2b-04af-4575-a343-435a689e779b&clip=11&mode=live&start=109.64)

[Classes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live)

[Overview](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live)

[You can get a long way in Python using the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=1.04) [built‑in scalar and collections types. For](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=2.96) [many problems, the built‑in types and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=5.27) [those available in the Python standard](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=6.87) [library are completely sufficient.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=8.31) [Sometimes, though, they aren't quite](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=10.54) [what's required and the ability to create](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=12.06) [custom types is where classes come in. In](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=13.91) [this module of Core Python: Getting](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=16.55) [Started, we'll define what we mean by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=18.86) [class. We'll investigate the relationship](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=20.08) [between classes and an object's type.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=23.08) [We'll see how to define new classes. We'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=25.84) [learn about instance methods, and we'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=28.85) [see how to add them to classes, and we'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=30.95) [look into the ubiquitous self argument of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=33.14) [instance methods. We'll discover how to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=35.03) [add initializers to classes. We'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=37.75) [discover how initializers are similar to,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=39.87) [but different from constructors that you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=41.87) [may be familiar with in other languages,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=43.51) [and we'll explore their role in helping](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=45.84) [enforcing variance in your programs. We'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=47.37) [look at how classes could collaborate, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=50.33) [we'll see how this could help you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=52.52) [decompose the problem space into](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=53.51) [manageable elements. We'll discuss](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=55.03) [techniques for separating your class'](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=57.51) [public APIs from their implementation](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=59.02) [details. We'll see how you can painlessly](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=60.85) [mix object‑oriented design with designs](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=63.71) [based around functions, and in doing so,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=65.73) [hopefully gain a deeper insight into](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=68.21) [Python's everything is an object approach.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=70.17) [We'll explore how classes intersect with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=72.74) [Python's notion of duck typing, and we'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=74.9) [look at the basics of class inheritance in Python.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=0&mode=live&start=77.27)

[Classes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=1&mode=live)

[As we've seen, all objects in Python have](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=1&mode=live&start=1.11) [a type, and when we report that type using](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=1&mode=live&start=3.14) [the type built‑in function, the result is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=1&mode=live&start=5.38) [couched in terms of a class. Classes are a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=1&mode=live&start=7.5) [means of defining the structure and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=1&mode=live&start=10.84) [behavior of objects at the time we create](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=1&mode=live&start=12.21) [the object. Generally speaking, the type](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=1&mode=live&start=14.02) [of an object is fixed throughout its](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=1&mode=live&start=16.32) [lifetime. As such, classes act as a sort](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=1&mode=live&start=17.98) [of template or pattern according to which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=1&mode=live&start=20.85) [new objects are constructed. The class of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=1&mode=live&start=22.63) [an object controls its initialization and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=1&mode=live&start=24.94) [which attributes and methods are available](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=1&mode=live&start=27.05) [through that object, for example, on a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=1&mode=live&start=28.94) [string object the methods we can use on](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=1&mode=live&start=30.95) [that object such a split are defined in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=1&mode=live&start=32.59) [the str class. Classes are a key piece of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=1&mode=live&start=34.73) [machinery for Object Oriented Programming.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=1&mode=live&start=38.39) [And although it's often true that OOP is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=1&mode=live&start=40.35) [useful for making complex problems more](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=1&mode=live&start=42.33) [tractable, it also commonly has the effect](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=1&mode=live&start=44.1) [of making the solution to simple problems](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=1&mode=live&start=46.27) [unnecessarily complex. A great thing about](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=1&mode=live&start=48) [Python is that it's highly object oriented](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=1&mode=live&start=50.9) [without forcing you to deal with classes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=1&mode=live&start=52.98) [until you really need them. This sets the language starkly apart from Java and C#.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=1&mode=live&start=54.66)

[Defining Classes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live)

[Python gives us the tools to define new](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=1.41) [classes, which can be completely novel or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=2.99) [based on existing classes. Class](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=5.2) [definitions are introduced by the class](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=7.31) [keyword, followed by the class name. By](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=9.08) [convention, new class names in Python use](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=11.96) [upper CamelCase, sometimes known as Pascal](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=14.05) [Case, with a capital letter for each and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=16.33) [every component word. Since classes are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=18.49) [awkward to define at the REPL, we'll be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=22.08) [using a Python module file to hold our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=23.71) [class definitions. Let's start with the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=25.49) [very simplest class to which we'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=27.85) [progressively add features. For this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=29.54) [module, I'll be using the pycharm Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=31.81) [IDE so that it's easy to follow code](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=33.85) [examples and their use in the REPL. In](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=35.79) [this example, we'll model a passenger](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=38.73) [aircraft flight between two airports by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=40.51) [putting this code into airtravel.py. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=42.37) [class statement introduces a new block, so](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=46.11) [we indent on the next line. Empty blocks](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=48.18) [aren't allowed, so the simplest possible](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=50.54) [class needs at least a do‑nothing pass](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=52.36) [statement to be syntactically admissible.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=54.41) [Just as with def for defining functions,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=57.24) [class is a statement that can occur](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=59.36) [anywhere in a program and which binds a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=61.02) [class definition to a class name. When the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=62.76) [top‑level code in the airtravel module is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=65.21) [executed, the class will be defined. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=67.06) [can now import our new class into the REPL](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=70.745) [and try it out. From airtravel, import](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=72.53) [Flight. The thing we've just imported is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=74.66) [the class object. Everything is an object](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=77.22) [in Python, and classes are no exception.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=79.36) [To use this class to mint a new object, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=82.14) [call it's constructor, which is done by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=84.21) [calling the class object just as we would](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=85.73) [a function. The constructor returns a new](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=87.77) [object, which we here assign to the name](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=90.02) [f. If we use the type function to request](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=92.055) [the type (f), we get class](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=95.46) ['airtravel.Flight' again. The type of f literally is the class.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=2&mode=live&start=97.22)

[Instance Methods](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live)

[Let's make our class a little more](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live&start=1.11) [interesting by adding a so‑called instance](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live&start=2.44) [method, which returns the flight number.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live&start=4.5) [Methods are just functions to find within](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live&start=6.51) [the class, and instance methods are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live&start=8.25) [functions which can be called on objects,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live&start=9.83) [or instances, of our class, such as f.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live&start=11.68) [Instance methods must accept a reference](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live&start=14.13) [to the actual instance on which the method](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live&start=16.1) [was called as the first argument. And by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live&start=17.97) [convention, this argument is always called](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live&start=20.03) [self. We have no way of configuring the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live&start=22.05) [flight number value yet, so we'll just](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live&start=24.4) [return a constant string to find the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live&start=26.03) [function number within the body of Flight](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live&start=28.05) [and return this string SN060. From a fresh](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live&start=30.01) [REPL, import Flight from airtravel.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live&start=34.71) [Construct a Flight instance bound to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live&start=37.8) [name f and call number on f. Notice that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live&start=39.48) [when we call the method, we do not provide](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live&start=44.41) [the instance f for the actual argument](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live&start=46.11) [self in the argument list. That's because](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live&start=48.01) [the standard method invocation form with a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live&start=50.41) [dot, f.number, is simply syntactic sugar](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live&start=52.24) [for Flight.number(f). If you try the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live&start=55.37) [latter, you'll find that it works as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live&start=59.06) [expected, although you almost never see this form used for real.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=3&mode=live&start=60.47)

[Instance Initializers](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live)

[This class isn't very useful, because it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=1.17) [can only represent one particular flight.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=3.04) [We need to make the flight number](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=5.44) [configurable at the point that the flight](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=6.58) [is created. To do that, we need to write](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=8.27) [an initialization method. If provided, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=10.68) [initialization method is called as part of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=13.91) [the process of creating a new object when](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=15.64) [we call the constructor. The initializer](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=17.44) [method must be called dunder init,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=19.74) [delimited by the double underscores used](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=21.67) [for Python runtime machinery. Like all](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=23.3) [other instance methods, the first argument](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=25.64) [to dunder init must be self. First, define](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=27.48) [dunder init in the body of the flight](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=31.2) [class. In this case, we also pass a second](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=32.54) [argument to dunder init, which is the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=35.1) [flight number. Dunder init creates a new](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=36.49) [reference on self called underscore number](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=42.9) [and points it at the argument number. If](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=45.07) [you're coming from a Java C# or C++](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=48.09) [background, it's tempting to think of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=50.31) [dunder init as being the constructor. This](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=51.87) [isn't quite accurate. In Python, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=54.08) [purpose of dunder init is to configure an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=56.37) [object that already exists by the time](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=58.19) [dunder init is called. The self argument](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=60.11) [is, however, analogous to this in Java,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=62.19) [C#, or C++. In Python, the actual](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=64.89500000000001) [constructor is provided by the Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=67.88) [runtime system, and one of the things it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=69.46) [does is check for the existence of an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=71.31) [instance initializer and call it when](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=72.81) [present. Within the initializer, we assign](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=74.45) [to an attribute of the newly created](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=77.49) [instance called underscore number.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=79.02) [Assigning to an object attribute that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=81.34) [doesn't yet exist is sufficient to bring](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=82.81) [it into being. The initializer should not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=84.56) [return anything; it simply modifies the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=87.53) [object referred to by self. Just as we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=89.47) [don't need to declare variables until we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=92.4) [create them, neither do we need to declare](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=93.95) [object attributes before we create them.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=95.75) [We choose underscore number with a leading](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=97.73) [underscore for two reasons. First, because](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=99.51) [it avoids a name clash with the method of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=101.92) [the same name. Methods are functions,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=103.57) [functions are objects, and these functions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=105.9) [are bound to attributes of the object. So](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=107.78) [we already have an attribute called number](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=109.66) [and we don't want to replace it. Second,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=111.41) [there's a widely followed convention that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=113.67) [the implementation details of an object,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=115.3) [which are not intended for consumption or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=117.03) [manipulation by clients of the object](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=118.71) [should be prefixed with an underscore. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=120.76) [also modify our number method to access](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=123.9) [the underscore number attribute and return](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=126.09) [it. Any arguments past the flight](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=127.94) [constructor will be forwarded to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=134.15) [initializer. So to create and configure](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=135.53) [our flight object, we can now call the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=137.35) [flight class and pass in the flight number](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=138.85) [as a string. We can then access the flight](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=140.67000000000002) [number through the number method. We can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=146.09) [also directly access the implementation](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=150.19) [details. Although this is not recommended](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=151.95) [for production code, it's very handy for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=154.48) [debugging in early testing. If you're](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=156.37) [coming from a bondage and discipline](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=159.29) [language like Java or C# with public,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=160.65) [private, and protected access modifiers,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=162.76) [Python's everything‑is‑public approach can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=165.45) [seem excessively open‑minded. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=166.82) [prevailing culture among Pythonistas is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=169.72) [that we're all consenting adults here. In](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=171.56) [practice, the leading underscore](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=173.83) [convention has proven sufficient](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=175.17) [protection even in large and complex](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=176.44) [Python systems we've worked with. People](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=177.975) [know not to use these attributes directly,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=180.39) [and in fact they tend not to. Like so many](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=182.64) [doctrines, lack of access modifiers is a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=185.26) [much bigger problem in theory than in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=187.47) [practice. It's good practice for the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=189.04) [initializer of an object to establish](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=192.88) [so‑called class invariants. The invariants](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=194.59) [or truths about objects of that class](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=196.6425) [should endure for the lifetime of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=199.17) [object. One such invariant for flights is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=200.61) [that the flight number always begins with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=203.34) [an uppercase two‑letter airline code,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=204.89) [followed by a three‑ or four‑digit route](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=206.77) [number. In Python, we can establish class](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=208.35) [invariants in the dunder init method and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=211.61) [raise exceptions if they can't be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=213.48) [attained. We first used string slicing in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=214.73) [str.isalpha to verify that the first two](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=218.2) [characters of the flight number are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=220.74) [alphabetic, raising a ValueError if not.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=222.11) [We then check if the same slice is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=224.55) [uppercase by using str isupper, again,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=228.1) [raising a ValueError if not. Finally, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=230.83) [use slicing, str isdigit and the int](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=234.9) [constructor to verify that the rest of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=237.17000000000002) [number comprises only digits and that it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=238.81) [represents a value between 0 and 9999;](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=240.77) [once again, raising a ValueError if not.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=244.245) [For the first time in this course, we also](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=248.7) [see the logical negation operator, not. Ad](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=251.57) [hoc testing in the REPL is a very](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=256.97) [effective technique during development. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=258.53) [can construct flights using valid flight](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=261.94) [numbers. If we try to use a flight number](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=263.8) [without letters at the front, we get a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=267.79) [ValueError. Similarly, if the letters at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=269.23) [the front aren't uppercase, we get a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=273.7) [ValueError with a different message. Here](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=275.15) [we try to use a flight number that doesn't](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=280.25) [have digits in the tail with predictable](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=281.7) [results. And in this case we get a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=283.65) [ValueError because the flight number has](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=288.6) [too many digits. Now that we're sure the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=290.1) [new flight objects have a valid flight](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=295.44) [number, we'll add a second method to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=297.03) [return just the airline code. Once the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=298.48) [class invariants have been established,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=300.42) [most query methods could be very simple;](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=301.94) [in this case, simply returning a slice of the stored flight number.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=4&mode=live&start=303.88)

[A Second Class](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live)

[One of the things we'd like to do with our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=1.04) [flight is accept seat bookings. To do](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=2.38) [that, we need to know the seating layout,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=4.58) [and for that we need to know the type of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=6.23) [aircraft. Let's make another class to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=7.57) [model different kinds of aircraft. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=9.69) [initializer creates four attributes for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=11.73) [the aircraft, registration number, a model](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=13.36) [name, the number of rows of seats, and the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=15.64) [number of seats per row. In a production](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=17.74) [code scenario, we could validate these](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=19.76) [arguments to ensure, for example, that the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=21.39) [number of rows was not negative. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=23.27) [registration method returns the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=29.2) [registration, and the model method returns](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=30.51) [the aircraft's model. This is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=35.46) [straightforward enough, but for the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=39.6) [seating plan, we'd like something a little](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=40.92) [more in line with our booking system. Rows](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=42.35) [in aircraft are numbered from 1, and the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=44.629999999999995) [seats within each row are designated with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=46.54) [letters from an alphabet, which omits I to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=48.2) [omit confusion with 1. We'll add a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=50.1925) [seating\_plan method, which returns the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=54.6) [allowed rows and seats as a tuple](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=56.13) [containing a range object and a string of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=57.84) [seat letters. This might be a bit much to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=61.33) [take in all at once, so it's worth pausing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=69.41) [for a second to make sure you understand](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=71.39) [how this function works. The range call](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=72.89) [produces an interval sequence of row](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=75.23) [numbers, up to the number of rows in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=76.83) [plane. The string and its slice method](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=78.61) [return a string with one character per](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=80.7) [seat. These two objects, the range and the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=82.17) [string, are bundled up into a tuple. With](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=84.42) [that in mind, let's construct a plane with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=87.61) [registration number G‑EUPT, model Airbus](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=89.53) [A319, 22 rows of seating, and 6 seats per](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=93.85) [row. We can access its registration,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=100.115) [model, and seating\_plan through the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=106.16) [associated instance methods. See how we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=110.03) [used keyword arguments for the rows and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=113.92) [seats for documentary purposes. Also](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=115.55) [recall the ranges are half open, so 23 is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=118.33) [intentionally 1 beyond the end of the range.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=5&mode=live&start=120.91)

[Collaborating Classes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=6&mode=live)

[The Law of Demeter is an object‑oriented](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=6&mode=live&start=1.18) [design principle that says you should](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=6&mode=live&start=3.04) [never call methods on objects you received](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=6&mode=live&start=4.64) [from other calls, or put another way, only](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=6&mode=live&start=6.41) [talk to your friends. We'll modify our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=6&mode=live&start=8.41) [Flight class to accept an aircraft object](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=6&mode=live&start=13.59) [when it is constructed, and we'll follow](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=6&mode=live&start=15.39) [the Law of Demeter by adding a method to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=6&mode=live&start=21.67) [report the aircraft model. This method](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=6&mode=live&start=23.29) [will delegate the aircraft on behalf of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=6&mode=live&start=26.35) [the client, rather than allowing the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=6&mode=live&start=27.91) [client to reach through the flight and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=6&mode=live&start=29.32) [interrogate the aircraft object directly.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=6&mode=live&start=30.99) [We also added docstring to the class.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=6&mode=live&start=37.44) [These work just like function and module](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=6&mode=live&start=40.44) [docstrings. We can now construct a flight,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=6&mode=live&start=42.14) [in this case flight number BA758, with a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=6&mode=live&start=49) [specific aircraft, another Airbus A319.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=6&mode=live&start=52.55) [Notice that we construct the Aircraft](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=6&mode=live&start=55.879999999999995) [object and directly pass it to the Flight](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=6&mode=live&start=57.87) [constructor without needing an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=6&mode=live&start=59.73) [intermediate named reference to it. Once](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=6&mode=live&start=60.92) [this is constructed, we can access the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=6&mode=live&start=65.45) [aircraft's model directly from our Flight object.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=6&mode=live&start=67.1)

[Moment of Zen](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=7&mode=live)

[Many moving parts combined in a clever box](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=7&mode=live&start=2.11) [are now one good tool. The aircraft model](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=7&mode=live&start=4.89) [method is an example of complex is better](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=7&mode=live&start=8.35) [than complicated. The Flight class is more](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=7&mode=live&start=10.63) [complex. It contains additional code to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=7&mode=live&start=13.23) [drill down through the aircraft reference](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=7&mode=live&start=15.51) [to find the model. However, all clients of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=7&mode=live&start=16.97) [flight can now be less complicated. None](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=7&mode=live&start=19.8) [of them need to know about the Aircraft](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=7&mode=live&start=21.92) [class, dramatically simplifying the system.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=7&mode=live&start=23.36)

[Booking Seats](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live)

[Now we can proceed with implementing a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=1.3) [simple booking system. For each flight we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=2.81) [simply need to keep track of who is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=4.99) [sitting in each seat. We'll represent the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=6.27) [seat allocations using a list of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=8.55) [dictionaries. The list will contain one](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=10.02) [entry for each seat row, and each entry](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=12.05) [will be a dictionary from seat letter to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=14.04) [occupant name. If the seat is unoccupied,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=15.98) [it will contain none. We initialize the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=18.52) [seating plan in the flight initializer](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=23.23) [using this fragment. In the first line, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=24.92) [retrieve the seating plan for the aircraft](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=27.12) [and use tuple unpacking to put the row and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=28.83) [seat identifiers into local variables. In](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=30.63) [the second line, we create a list for the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=35.88) [seat allocations. Rather than continually](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=37.48) [deal with the fact that row indices are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=42.65) [one‑based, whereas Python lists are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=44.0325) [zero‑based, we choose to waste one entry](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=45.75) [at the beginning of the list. This first](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=47.98) [wasted entry is the single element list](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=50.05) [containing none. To this single element](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=51.75) [list, we concatenate another list](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=54.21) [containing one entry for each real row in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=55.49) [the aircraft. This list is constructed by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=57.47) [a list comprehension, which iterates over](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=60.14) [the rows objects, which is the range of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=61.76) [row numbers retrieved from the \_aircraft](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=63.87) [on the previous line. We're not actually](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=66.03) [interested in the row number, since we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=70.89) [know it will match with the list index in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=72.29) [the final list, so we discard it by using](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=73.83) [the dummy underscore variable. The item](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=75.65) [expression part of the list expression is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=77.85) [itself a comprehension, specifically a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=79.4) [dictionary comprehension. This iterates](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=81.42) [over each letter for the row and creates a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=83.595) [mapping from the single letter string to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=85.51) [none to indicate an empty seat. We use a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=87.15) [list comprehension rather than list](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=89.8) [replication with the multiplication](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=91.29) [operator because we want a distinct](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=92.81) [dictionary object to be created for each](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=94.32) [row. Before we go further, let's test our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=96.09) [code in the REPL. We'll create Flight](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=101.61) [BA758 from an AirbusA319, just like](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=106.11) [before. Thanks to the fact that everything](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=109.85) [is public, we can access implementation](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=117.51) [details during development, and it's clear](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=119.24) [enough that we're doing so since the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=120.96) [leading underscores remind us what's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=122.32) [public and what's not. That's accurate,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=123.65) [but not particularly beautiful. Let's try](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=128.01) [again with pretty print. Import the pprint](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=130.3) [function from the pprint module and rename](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=134.47) [it to pp. Then use pp to print the seating](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=136.48) [structure. Perfect. Now we'll add behavior](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=141.235) [to flight to allocate seats to passengers.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=153.85) [To keep this simple, a passenger will](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=155.9425) [simply be a string name. Most of this code](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=157.77) [is validation of the seat designator, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=164.26) [it contains some interesting snippets.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=166.02) [Methods or functions so deserve doc](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=169.92) [strings too. We get the seat letter by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=171.67) [using negative indexing into the seat](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=175.08) [string. We test that the seat letter is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=176.7) [valid by checking for membership of seat](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=180.28) [letters using the in membership testing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=182.17) [operator. We extract the row number using](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=184.75) [string slicing to take all but the last](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=188.39) [character. We try to convert the row](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=190.24) [number substring to an integer using the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=193.70499999999998) [int constructor. If this fails, we catch](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=195.63) [the value error and, in the handler, raise](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=198.82) [a new value error with a more appropriate](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=200.77) [message payload. We conveniently validate](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=202.67) [the row number by using the in operator](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=207.23) [against the rows object, which is a range.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=209.16) [We can do this because range supports the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=211.64) [container protocol. We checked that the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=213.47) [requested seat is unoccupied, using an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=217.73) [identity test with none. If it's occupied,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=219.64) [we raise the value error. If we get this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=223.36) [far, everything's in good shape and we can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=228.2) [assign the seat. It also contains a bug](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=229.55) [that we'll discover soon enough. Trying](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=233.38) [our seat allocator at the REPL, we first](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=237.44) [construct a flight. We then put Python's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=239.27) [BDFL, Guido van Rossum, in seat 12A. Early](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=245.47) [on in your object‑oriented Python career,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=252.58) [you're likely to see type error messages](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=254.41) [like this quite often. The problem has](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=256.12) [occurred because we forgot to include the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=258.32) [self argument in the definition of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=259.99) [allocate\_seat method. Once we fix that, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=261.61) [can try again. Construct the flight](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=267.17) [object, allocate seat 12A to Guido,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=271.12) [attempt to allocate 12A to Rasmus Lerdorf,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=282.625) [and see that it raises a value error to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=290.27) [prevent us from assigning two people to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=294.75) [the same seat. Let's seat Bjarne](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=296.23) [Stroustrup and Anders Hejlsberg next to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=299.03) [one another on Row 15. When we try to put](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=300.91) [Yukihiro Matsumoto in E27, we get a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=308.49) [ValueError telling us that we've used an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=311.265) [invalid seat letter. We'll put John](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=312.64) [McCarthy and Rich Hickey in Row 1, but](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=319.81) [we'll get yet another ValueError when we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=323.7) [try to put Larry Wall in seat DD. Now we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=325.46) [can see our seating chart using the pprint](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=332.08) [function. The Dutchman is quite lonely](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=333.95) [there on row 12, so we'd like to move him](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=346.71) [back to Row 15 with the Danes. To do so, we'll need a relocate\_passenger method.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=8&mode=live&start=348.45)

[Methods for Implementation Details](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live)

[First, we'll perform a small refactoring](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=1.14) [and extract the seat designator parsing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=2.86) [and validation logic into its own method,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=4.58) [\_parse\_seat. We use a leading underscore](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=6.975) [here because this method is an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=11.74) [implementation detail. The new \_parse\_seat](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=12.82) [method returns a tuple with an integer row](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=17.01) [number and a seat letter string. This](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=18.895) [leaves allocate seat much simpler since it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=20.87) [can delegate most of its work to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=22.77) [\_parse\_seat. Notice that method calls](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=24.92) [within the same object, such as this call](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=27.89) [to \_parse\_seat, also require explicit](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=29.7) [qualification with the self. prefix. Now](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=32.29) [we've laid the groundwork for our relocate](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=37.57) [passenger method. This parses and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=39.27) [validates the from seat and to seat](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=42.405) [arguments and then moves the passenger to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=45.435) [the new location. It's also getting](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=47.01) [tiresome recreating the flight object each](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=53.17) [time, so we'll add a module level](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=54.45) [convenience function for that, too. We'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=56.26) [call the function make\_flight. First, it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=58.32) [will construct a flight object with its](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=60.98) [associated aircraft, then we'll allocate a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=62.78) [seat to Guido van Rossum, Bjarne](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=66.87) [Stroustrup,Anders Hejlsberg, John](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=70.375) [McCarthy, and Rich Hickey. Finally, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=76.88) [return the flight. It's quite normal to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=82.49) [mix related functions and classes in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=85.54) [same module like this. Now from the repel,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=87.19) [we can import the make\_flight function and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=90.16) [use it to replace the boiler code we've](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=92.94) [been using to construct flight objects.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=94.49) [You may find it remarkable we have access](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=97.44) [to the Flight class when we have only](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=99.27) [imported a function, make\_flight. This is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=100.63) [quite normal and it's a powerful aspect of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=103.07) [Python's dynamic type system that allows](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=104.92) [us this very loose coupling between code.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=106.79) [Let's get on and move Guido back to Row 15](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=109.84) [with his fellow Europeans. We'll use](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=111.92) [flight relocate\_passenger method to move](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=114.56) [him from 12A to 15D. If we print the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=116.51) [seating chart, we can see that he is now](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=120.84) [in the right place. It's important during](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=122.64) [booking to know how many seats are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=127.32) [available. To this end, we'll write a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=128.52) [num\_available\_seats method. This is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=130.23) [achieved using two nested generator](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=133.51) [expressions. The outer expression filters](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=135.34) [for all rose, which are not none. This](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=137.49) [excludes are dummy first row. The value of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=139.52) [each item in the outer expression is the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=142.17) [sum of the number of none values in each](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=143.66) [row. We split this outer expression over](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=145.88) [three rows to improve readability. This](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=147.78) [inner expression iterates over values of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=150.55) [the dictionary and adds one for each none](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=152.21) [found. We can make a flight and ask how](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=154.26) [many seats it has available. We can verify](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=163.57) [this result by multiplying the number of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=166.25) [seats per row, 5, by the number of rows on](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=167.93750000000003) [the plane, 22, and subtracting the number](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=170.14) [of occupied seats, 5, resulting in 127, the same number we got above.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=9&mode=live&start=172.48)

[Object-Oriented Design with Function Objects](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live)

[Now we'll show how it's quite possible to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=1.64) [write nice object‑oriented code without](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=3.48) [needing classes. We have a requirement to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=5.33) [produce boarding cards for our passengers](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=8.04) [in alphabetical order, however, we realize](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=9.74) [that, by following the engineering](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=12.18) [principle of separation of concerns, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=13.64) [Flight class is probably not a good home](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=15.9) [for details of printing boarding passes.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=17.55) [We could go ahead and create a boarding](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=19.84) [card printer class, but that's probably](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=21.33) [overkill. Remember that functions are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=23.28) [objects too, and are perfectly sufficient](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=25.37) [for many cases. Don't feel compelled to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=27.19) [make classes and objects without a good](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=29.33) [reason. Rather than have a card printer](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=30.9) [query all the passenger details from the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=34.53) [flight, we'll follow another](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=35.84) [object‑oriented design principle of Tell,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=37.09) [Don't Ask and have the flight tell a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=39.12) [simple card printing function what to do.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=41.26) [First, the card\_printer, which is just a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=45.64) [module‑level function. We first create the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=47.19) [primary output string from the boarding](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=51.74) [card. The new Python feature here is the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=53.42) [use of line continuation backslash](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=57.62) [characters, which allow us to split a long](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=59.36) [statement over several lines. This is used](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=61.11) [together with implicit string](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=64.82) [concatenation of adjacent strings to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=66.43) [produce one long string with no line](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=67.98) [breaks. We then measure the length of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=69.73) [output line and build some banners and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=75.5) [borders around it. Finally, we concatenate](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=77.1) [the lines together using the join method](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=86.66) [called on a new line separator, before](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=88.53) [printing the whole card followed by a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=92.43) [blank line. Note that the card\_printer](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=94.04) [doesn't know anything about flights or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=97.4) [aircraft. It's very loosely coupled. You](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=99.04) [can probably easily envisage an HTML](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=102.77) [card\_printer that has the same interface.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=104.84) [To the Flight class, we add a new method](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=108.325) [make\_boarding\_cards, which accepts a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=112.12) [card\_printer. This calls the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=113.72) [implementation detail \_passenger\_seats](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=117.63) [method, sorts the results, and loops over](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=119.48500000000001) [the resulting passenger\_seat tuples. For](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=121.85) [each of these, it then calls the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=125.25) [card\_printer that was passed in. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=126.34) [\_passenger\_seats method is, in fact, a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=131.01) [generator function, which searches all](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=132.94) [seats for occupants, yielding the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=134.56) [passenger and the seat number as they're](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=136.07) [found. It first determines the number of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=137.55) [rows and seat letters in each row. Then it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=140.56) [loops over the row\_numbers, and for each](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=145.29) [row loops over the seat\_letters. It finds](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=148.76) [the passenger in that seat, and if the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=152.48) [passenger is not none, yields the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=157.71) [passenger and seat information. Now, if we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=159.49) [run this in the REPL, we can see that the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=166.83) [new boarding card printing system works.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=168.49) [We import the console\_card\_printer and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=170.52) [make flight functions, make a new flight](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=172.26) [object, and then print the boarding cards with the console\_card\_printer function.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=10&mode=live&start=174.37)

[Polymorphism and Duck Typing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live)

[Polymorphism is a programming language](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=1.09) [feature which allows us to use objects of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=2.85) [different types through a uniform](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=4.46) [interface. The concept of polymorphism](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=5.78) [applies to functions and more complex](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=8.3) [objects. We've just seen an example of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=10.14) [polymorphism with the card printing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=12.76) [example. The make\_boarding\_card method](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=14.3) [didn't need to know about an actual or, as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=16.81) [we say, concrete card printing type, only](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=18.84) [the abstract details of its interface,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=21.17) [essentially just the order of its](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=23.57) [arguments. Replacing our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=24.94) [console\_card\_printer with the putative](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=27.3) [HTML card printer would exercise](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=29.01) [polymorphism. Polymorphism in Python is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=31.65) [achieved through duck typing. Duck typing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=34.26) [is in turn named after the duck test](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=36.58) [attributed to James Whitecomb Riley, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=38.49) [American poet. When I see a bird that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=40.3) [walks like a duck and swims like a duck](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=42.54) [and quacks like a duck, I call that bird a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=44.45) [duck. Duck typing, where an object's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=46.46) [fitness for a particular use is only](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=49.32) [determined at runtime, is the cornerstone](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=50.87) [of Python's object system. This is in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=52.75) [contrast to statically typed languages](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=54.97) [where a compiler determines if an object](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=56.75) [can be used, and in particular it means](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=58.39) [that an object's suitability is not based](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=60.67) [on inheritance hierarchies, base classes,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=62.54) [or anything except the attributes an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=64.53) [object has at the time of use. Again, this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=66.26) [is in contrast of languages such as Java,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=69.83) [which depend on nominal subtyping through](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=71.64) [inheritance from base classes and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=73.46) [interfaces. We'll talk more about](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=74.92) [inheritance in the context of Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=76.81) [shortly. Let's return to our Aircraft](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=78.27) [class. The design of this class is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=81.04) [somewhat flawed in that objects](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=83.17) [instantiated using it depend on being](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=84.8) [supplied with the seating configuration](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=86.48) [that matches the aircraft model, which for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=88.02) [the purposes of this exercise, we assume](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=89.9) [is fixed per model. Better and simpler,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=91.69) [perhaps, is to get rid of the Aircraft](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=94.14) [class entirely and make separate classes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=95.72) [for each specific model of aircraft with a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=97.49) [fixed seating configuration. Here's an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=99.46) [Airbus A319 and a Boeing 777. These two](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=103.86) [Aircraft classes have no explicit](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=116.02) [relationship to each other or to our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=117.56) [original Aircraft class beyond having](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=119.17) [identical interfaces to each other with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=121.1) [the exception of the initializer, which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=123) [now takes fewer arguments. As such, we can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=124.89) [use these new types in place of each](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=127.64) [other. Let's change our make\_flight method](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=129) [into make\_flights to use them. It will](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=133.76) [first construct Flight BA758 with an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=138.73) [AirbusA319 and allocate some seats to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=141.07) [passengers. It will then construct Flight](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=144.46) [AF72 with the Boeing777 and seat some](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=149.68) [passengers there. Finally, it will return](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=152.27) [both flights as a tuple. The different](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=155.97) [types of aircraft both work fine when used](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=159.62) [with Flight because they both quack like](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=161.5) [ducks or fly like planes or something. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=163.25) [import everything from airtravel and then](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=169.54) [make the flights, binding them to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=171.36) [names f and g. We can see that f has model](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=172.87) [Airbus A319 and g is a Boeing 777. F has](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=178.13) [127 seats available, while the much larger](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=183.7) [Boeing has 491 seats available. We can, of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=186.53) [course, relocate passengers on the flights](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=191.07) [and make boarding cards as before. Duck](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=197.14) [typing and polymorphism is very important](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=203.34) [in Python. In fact, it's the basis for the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=205.35) [collection protocols we discussed such as iterator, iterable, and sequence.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=11&mode=live&start=207.41)

[Inheritance and Implementation Sharing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live)

[Inheritance is a mechanism whereby one](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=0.99) [class, the sub class, can be derived from](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=2.81) [another class, the base class, allowing us](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=4.9) [to make behavior more specific in the sub](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=7.15) [class. In nominally‑typed languages, such](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=9.01) [as Java, class‑based inheritance is the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=11.8) [means by which runtime polymorphism is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=13.88) [achieved. Not so in Python, as we've just](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=15.7) [demonstrated. The fact that no Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=18.42) [method calls or attribute lookups are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=20.83) [bound to actual objects until the point at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=22.41) [which they're called, a quality known as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=24.23) [late binding, means we can attempt](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=26.15) [polymorphism with any object, and it will](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=27.97) [succeed if the object fits. Although](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=29.8) [inheritance in Python can be used to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=33.02) [facilitate polymorphism, after all derived](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=34.44) [classes will have the same interface as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=36.98499999999999) [base classes, inheritance in Python is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=38.3725) [mostly useful for sharing implementation](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=40.38) [between classes. As usual, this will make](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=42.31) [much more sense with an example. We would](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=45.56) [like our aircraft classes, AirbusA319 and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=48.4) [Boeing777 to provide a way of returning](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=50.92) [the total number of seats. We'll add a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=53.2) [method called num\_seats to both classes to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=55.96) [do this. The implementation can be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=57.96) [identical in both cases, since it could be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=60.23) [calculated from the seating plan.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=62.05) [Unfortunately, we now have duplicate code](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=66.465) [across two classes, and as we add more](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=71.04) [aircraft types, the code duplication will](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=72.89) [only worsen. The solution we'll look at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=74.8) [here is to extract the common elements of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=79.67) [AirbusA319 and Boeing777 into a base class](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=81.34) [from which both aircraft types will](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=84.53) [derive. Let's recreate the class Aircraft,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=85.85) [this time with the goal of using it as a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=92.83) [base class. It contains just the method we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=94.33) [want to inherit into the derived class,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=97.13) [num\_seats. This class isn't usable on its](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=98.795) [own because it depends on a method called](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=104.9) [seating\_plan, which isn't available in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=106.52) [Aircraft. Any attempt to use Aircraft](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=108.14) [standalone will fail. Here we construct an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=112.65) [aircraft and ask for its number of seats.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=114.98) [Since this aircraft instance doesn't have](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=118.49) [a seating plan method, we get an attribute](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=120.21) [error. The class is abstract insofar as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=122.2) [it's never useful to instantiate it alone.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=125.26) [So how can we use aircraft meaningfully?](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=128.84) [That's where derived classes come in. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=130.91500000000002) [specify inheritance in Python using](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=135.53) [parentheses containing the base class name](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=137.28) [immediately after the class name in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=139.13) [class statement. Here's the Airbus class,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=140.88) [now inheriting from Aircraft, and this is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=145.55) [the Boeing class. Let's exercise them at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=150.96) [the REPL. Now, our AirbusA319 objects have](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=155.08) [a num\_seats method, as do instances of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=159.35) [Boeing777. We can see that both aircraft](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=164.27) [subclasses inherited the num\_seats method,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=170.48) [which now works as expected because the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=172.44) [call to a seating plan, defined on both](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=174.07) [sub classes, is successfully resolved on](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=175.92) [the self object at runtime. Now that we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=178.03) [have the base Aircraft class, we can hoist](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=181.34) [other common functionality into it. In](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=183.2) [this case, initializer and registration](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=185.31) [methods are identical between the two](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=187.24) [subtypes. Now the derived classes only](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=188.64) [contain the specifics for that aircraft](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=193.51) [type. All shared functionality is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=195.19) [inherited from the base class. Thanks to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=201.8) [duck‑typing, inheritance is less used in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=207.22) [python than in other languages. This is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=209.22) [generally seen as a good thing because](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=211.11) [inheritance is a very tight coupling between classes.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=12&mode=live&start=212.8)

[Summary](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live)

[Classes are an important tool for any](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=1.04) [Python programmer, and this module](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=2.74) [introduced the essentials of how classes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=4.33) [work in Python. While there is certainly](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=5.97) [more to know about classes in Python, much](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=8) [more in fact, for many Python users this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=10.13) [may be all that you need to know to get](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=12.19) [your work done. Indeed, if you follow our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=13.68) [advice to reserve classes for when other](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=16.26) [simpler techniques fall short, you may be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=18.2) [surprised at how infrequently you really](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=20.23) [need them at all. In this module, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=22.02) [learned that all types in Python have a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=24.04) [class. Classes define the structure and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=26.06) [behavior of an object. The classes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=28.97) [determine when an object is created and is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=31.63) [fixed for the lifetime of the object in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=33.59) [the general case. Classes are the key](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=35.17) [support for object‑oriented programming in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=38.01) [Python. Classes are defined using the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=39.79) [class keyword followed by the class name,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=42.13) [which is in camelCase. Instances of a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=44.3) [class are created by calling the class as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=47.19) [if it were a function. Instance methods](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=49.28) [are functions defined inside the class,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=51.83) [which should accept an object instance](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=53.58) [called self as the first parameter.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=55.08) [Methods are called using the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=57.34) [instance.method syntax, which is syntactic](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=59.14) [sugar for passing the instance as the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=61.52) [formal self argument to the method. An](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=63.17) [optional special initializer method called](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=66.27) [dunder init can be provided, which is used](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=68.22) [to configure the self object at creation](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=70.15) [time. If present, the constructor calls](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=71.96) [the dunder init method. Dunder init is not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=74.79) [the constructor. The object has been](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=78.03) [constructed by the time the initializer is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=79.8) [called. Arguments passed to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=81.48) [constructor are forwarded to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=83.84) [initializer. Instance attributes are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=85.12) [brought into existence simply by assigning](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=87.87) [to them. Attributes and methods which are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=89.79) [implementation details are, by convention,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=92.34) [prefixed with an underscore. There are no](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=94.54) [public, protected or private access](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=96.68) [modifiers in Python. Access to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=98.36) [implementation details from outside the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=100.97) [class can be very useful during](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=102.53) [development, testing, and debugging. Class](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=103.91) [invariants should be established in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=106.96) [initializer. If the invariants can't be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=108.46) [established, raise exceptions to signal](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=110.4) [failure. Methods have docstrings just like](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=112.34) [regular functions. Classes can have](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=115.56) [docstrings. Even within an object, method](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=118.23) [calls must be preceded with self. You can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=121.52) [have as many classes and functions in a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=124.48) [module as you wish. Related classes and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=125.96) [global functions are usually grouped](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=128.25) [together this way. Polymorphism in Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=129.63) [is achieved through duck‑typing, where](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=132.59) [attributes and methods are only resolved](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=134.2) [at point of use, late binding.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=135.685) [Polymorphism in Python does not require](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=138.305) [shared base classes or named interfaces.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=140.53) [Class inheritance in Python is primarily](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=143.93) [useful for sharing implementation, rather](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=145.44) [than being necessary for polymorphism. All](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=147.25) [methods are inherited, including special](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=150.29) [methods like the initializer. Along the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=152.09) [way, we found that strings support slicing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=154.82) [because they implement the sequence](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=157.33) [protocol. Following the Law of Demeter can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=158.64) [reduce coupling. We can nest](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=161.67) [comprehensions. It can sometimes be useful](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=164.09) [to discard the current item in a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=167.13) [comprehension using a dummy reference,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=169.01) [conventionally, the underscore. When](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=170.17) [dealing with one‑based collections, it's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=172.73) [often easier just to waste one list entry.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=174.42) [Don't feel compelled to use classes when a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=177.74) [simple function will suffice. Functions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=179.47) [are also objects. Complex comprehensions](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=181.56) [or generator expressions can be split over](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=184.505) [multiple lines to aid readability.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=186.52) [Statements can be split over multiple](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=189.14) [lines using the backslash line](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=190.61) [continuation character. Use this feature](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=192.375) [sparingly, and only when it improves](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=194.48) [readability. Object‑oriented design, where](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=196.24) [one object tells another information, can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=199.46) [be more loosely coupled than those where](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=201.72) [one object queries another. Tell, don't](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=203.15) [ask. In the next module of Core Python:](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=205.48) [Getting Started, we'll take a look at how](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=209.44) [to work with file I/O in Python, both for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=211.07) [working with text, as well as binary data.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=213.3) [As part of this, we'll introduce you to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=215.77) [the with block, Python's approach to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=217.41) [managing resources like files. Thanks for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=219.07) [watching, and we'll see you in the next module.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=47b1b923-f25c-4905-8e74-1ff976fb1728&clip=13&mode=live&start=221.64)

[File IO and Resource Managements](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live)

[Overview](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live)

[File I/O, that is, reading from and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=0.99) [writing to files, is at the heart of a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=3.28) [great many programs. It's unsurprising](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=4.95) [then that Python provides a sophisticated](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=7.66) [array of support for working with both](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=9.29) [binary and text files, with mechanisms for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=10.81) [doing everything from reading a specific](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=13.05) [byte in a file iterating over lines of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=14.64) [text. Files are just one example of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=16.71) [objects representing resources, elements](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=20.5) [of a program that should be released or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=22.65) [closed after use. Since managing resources](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=24.27) [is critical for proper functioning of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=26.825) [programs, Python provide special syntax](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=28.59) [and protocols that help you work with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=30.87) [them. In this module of Core Python:](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=32.23) [Getting Started, we'll look at the core](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=34.88) [functions for opening files in Python.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=36.63) [We'll discuss the difference between text](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=39.34) [mode and binary mode when interacting with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=41) [files. We'll see how to read and write](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=42.83) [from files. And we'll see how to close](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=45.63) [them explicitly. We'll introduce you to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=48.42) [context managers, Python's support for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=51.23) [automatically managing resources. We'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=53.21) [show you Python's with keyword for using](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=55.96) [context managers. And we'll show you how](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=57.91) [to use with‑blocks for running code that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=60.51) [uses a resource. We'll take a deep look at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=62.26) [using Python to work with binary file](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=65.17) [formats. We'll discuss the more abstract](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=66.96) [notion of file‑like objects. And we'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=69.85) [look at some tools for creating context managers.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=0&mode=live&start=73.08)

[Opening Files](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live)

[To open a file in Python, we call the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=1.04) [built‑in open function. This takes a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=2.84) [number of arguments, but the most commonly](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=4.82) [used are: file, the path to the file, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=6.88) [this is required; mode: read, write,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=9.23) [append and binary or text. This is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=12.88) [optional, but we recommend always](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=15.21) [specifying it for clarity; explicit is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=16.87) [better than implicit. Encoding: If the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=19.14) [file contains encoded text data, which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=22.46) [encoding to use. It's often a good idea to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=24.56) [specify this. If you don't specify it,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=26.86) [Python will choose a default encoding for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=29.06) [you. At the file system level, files](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=30.88) [contain only a series of bytes. Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=34.23) [distinguishes between files opened in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=36.49) [binary and text mode, even when the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=38.23) [underlying operating system doesn't. Files](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=40.11) [opened in binary mode return and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=42.65) [manipulate their contents as bytes objects](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=44.41) [without any decoding. Binary mode reflects](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=46.48) [the raw data in the file. A file opened in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=49.16) [text mode treats its contents as if it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=52.33) [contains text strings of the \_\_\_\_\_ type,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=54.1) [the raw bytes having been first decoded,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=56.35625) [using a platform‑dependent encoding or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=58.42) [using the specified encoding if given. By](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=60.35) [default, text mode files also engage](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=62.96) [support for Python's universal new lines.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=65.02) [This causes translation between a portable](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=67.21000000000001) [single new line character in our program](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=69.46) [strings, /n, in a platform‑dependent new](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=71.28999999999999) [line representation of the raw bytes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=74.11) [stored in the file system; for example](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=75.78) [carriage return, new line, /r/n on](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=77.555) [Windows. Getting the encoding right is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=80.16) [crucial for correctly interpreting the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=83.5) [contents of a text file, which is why we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=85.05) [labor the point. If you don't specify an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=86.78) [encoding, Python will use the default from](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=88.9) [sys.getdefaultencoding. Ours is utf‑8, but](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=90.97) [there's no guarantee that the default](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=94.85) [encoding on your system, is the same as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=96.375) [the default encoding on another system](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=98.01) [with which you wish to exchange files.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=99.76) [It's better for all concerned to make a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=102.07) [conscious decision about the text‑to‑bytes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=103.7) [encoding. You can get a list of supported](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=105.47) [text encodings in the Python documentation.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=1&mode=live&start=107.55)

[Writing Text](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live)

[Let's start by writing some texts to a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=1.04) [file. We'll be explicit about using the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=2.72) [UTF‑8 encoding because we have no way of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=4.74) [knowing what your default encoding is.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=6.99) [We'll use keyword arguments to make things](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=8.75) [clearer still. We'll assign to f the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=10.64) [result of calling open. The first argument](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=13.27) [is the file name. The next argument is a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=15.46) [string containing letters with different](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=17.49) [meanings. In this case, w means write and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=19.15) [t means text. All mode strings should](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=21.655) [consist of a read, write, or append mode.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=25.14) [One of the preceding should be combined](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=28.14) [with a selector for text or binary mode.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=29.74) [So typical mode strings might be wb, write](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=32.245) [binary, or at, append text. Although both](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=35.64) [parts of the mode code support defaults,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=39.22) [we recommend being explicit for the sake](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=41.05) [of readability. The exact type of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=42.86) [object returned by open depends on how the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=45.64) [file was opened, dynamic typing in action,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=47.53) [but for our purposes, it's sufficient to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=49.83) [know that the object returned is a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=51.91) [file‑like object, and as such, we can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=53.26) [expect it to support certain attributes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=55.26) [and methods. We've shown previously how we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=56.95) [can request help for modules and methods](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=59.84) [and types, but in fact, we can request](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=61.74) [help on instances, too. This makes sense](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=63.73) [when you remember that everything is an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=66.4) [object. Let's call help on our file f.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=67.96) [Browsing through the help, we can see that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=71.13499999999999) [f supports a method write. Quit the help](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=73.3) [with Q and continue with the REPL. We'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=76.11) [write the string, What are the roots that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=78.43) [clutch, to our file. The call returns the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=80.4) [number of code points, or characters,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=83.91) [written to the file. A few more lines,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=85.58) [what branches grow, at 19 code points, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=88.625) [Out of this stony rubbish, with 27 code](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=92.08) [points. Note that it's the caller's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=94.48) [responsibility to provide newline](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=97.18) [characters when they're needed. There's no](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=98.8) [write line method on Python file objects.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=100.53) [When we finished writing, we should](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=104.24) [remember to close the file by calling the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=105.69) [close method. Note that when we close the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=107.46) [file, all the contents become visible to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=109.86) [other programs. Closing files is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=111.79) [important. If you now exit the REPL and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=113.63) [look at your file system on UNIX with ls](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=116.75) [‑l, you should see the wasteland.txt file](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=118.5325) [with 78 bytes. On Windows, you can do the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=121.55) [same with dir. Here you should see](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=124.7) [wasteland.txt with 79 bytes, 1 more than](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=127.64) [on UNIX, because Python's universal](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=130.83) [newline behavior for files has translated](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=132.56) [the line ending to your platform's native](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=134.52) [endings. The number returned by the write](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=136.17) [method is the number of code points, or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=139.06) [characters in the string passed to write,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=140.68) [not the number of bytes written to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=142.45) [file after encoding a universal newline](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=144.02) [translation. In general, when working with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=146.11) [text files, you cannot sum the quantities](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=148.55) [returned by write to determine the length of the file in bytes.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=2&mode=live&start=150.6)

[Reading Text](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live)

[To read the file back, we use open again,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=1.04) [but pass a different mode string, open](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=3.26) [wasteland.txt, mode, rt, encoding= utf‑8.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=5.65) [In this case, we use the rt mode for read](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=9.7225) [text. If we know how many bytes to read,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=12.49) [or if we want to read the whole file, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=15.77) [can use read. Looking back through our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=17.53) [REPL, we can see that the first write was](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=19.66) [32 characters long. We can read that back](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=21.5) [with the call to the read method. In text](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=24.03) [mode, the read method accepts the number](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=27.03) [of characters to read from the file, not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=28.63) [the number of bites. The call returns the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=30.47) [text and advances the file pointer to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=32.77) [end of what was read. The return type is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=34.65) [struck because we opened the file in text](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=36.99) [mode. To read all of the remaining data in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=39.05) [the file, we can call read without any](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=41.81) [argument, giving us parts of two lines in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=43.58) [one string. Note the new line character in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=45.7) [the middle. At the end of the file,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=47.85) [further calls to read return an empty](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=50.35) [string. Normally, when we have finished](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=52.18) [reading a file, we would close it, but for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=54.18) [the purposes of this exercise, we'll keep](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=56.02) [the file open and move the file pointer](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=57.67) [back to the beginning of the file using](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=59.49) [the seek method with a 0 offset from the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=61.16) [start of the file. The return value is the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=63.31) [new file pointer position. As a quick](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=66.67) [aside, it's important to note that for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=69.09) [text mode files, seek cannot be used to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=71.03) [move to an arbitrary offset, in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=73.25) [particular, when seeking from the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=75.26) [beginning of the file, as we do here, the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=76.67) [only legal values for offset are 0 and any](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=78.64) [value returned by the file's tell method.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=81.18) [Any other values will result in undefined](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=83.94) [behavior. Using read for text is quite](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=86.21) [awkward, and thankfully Python provides](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=90.16) [better tools for reading text files line](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=91.8) [by line. The first of these is the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=93.63) [readline function. The first call to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=95.76) [readline reads to the first new line. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=97.58) [second call reads to the end of the file.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=100.66) [The returned lines are terminated by a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=103.6) [single new line character if there is one](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=105.21) [present in the file. The last line here](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=107.03) [does not terminate with a new line because](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=109.11) [there's no new line sequence at the end of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=110.66) [the file. You shouldn't rely on the string](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=112.16) [returned by readline being terminated by a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=114.21) [new line. Again, the universal newline](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=116.1) [support will have translated to /in from](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=118.47) [whatever the platform native newline](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=120.79) [sequence is. Once we reach the end of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=122.33) [file, further calls to readline return an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=125.45) [empty string. Let's rewind again with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=127.46) [g.seek0. Sometimes when we know we want to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=130.47) [read every line in the file, and we're](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=134.74) [sure we have enough memory, we can read](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=136.25) [all lines into a list with the readlines](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=138.07) [method. This is particularly useful if](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=140.08) [parsing the file involves hopping](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=142.9) [backwards and forwards between lines. It's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=144.41) [much easier to do this with a list of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=146.51) [lines, then with file streams of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=147.97) [characters. This time, we'll close the file before moving on.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=3&mode=live&start=149.26)

[Appending Text](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=4&mode=live)

[Sometimes we'd like to append to an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=4&mode=live&start=1.04) [existing file. We can do that by opening](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=4&mode=live&start=2.57) [the file with mode a, which opens the file](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=4&mode=live&start=4.57) [for writing, appending to the end of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=4&mode=live&start=6.73) [file if it already exists. In this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=4&mode=live&start=8.36) [example, we can bind that with t to be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=4&mode=live&start=10.61) [explicit about using text mode,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=4&mode=live&start=12.37) [open('wasteland.txt', mode='at' encoding='](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=4&mode=live&start=14.14) [utf‑8'. Although there's no WriteLine](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=4&mode=live&start=17.68) [method in Python, there is a writelines](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=4&mode=live&start=20.94) [method, which writes an iterable series of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=4&mode=live&start=22.93) [strings to a stream. If you want line](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=4&mode=live&start=24.62) [endings on your strings, you must provide](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=4&mode=live&start=27.12) [them yourself. This seems odd at first,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=4&mode=live&start=28.98) [but it preserves symmetry with read lines](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=4&mode=live&start=31.35) [while also giving us the flexibility for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=4&mode=live&start=33.26) [using writelines to write any iterable](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=4&mode=live&start=35.16) [series of strings to a file. Son of man,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=4&mode=live&start=36.92) [you cannot say or guess, for you know only](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=4&mode=live&start=39.58) [a heap of broken images where the sun](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=4&mode=live&start=42.11) [beats. Notice that only three lines are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=4&mode=live&start=44.07) [completed here. I say completed because](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=4&mode=live&start=47.12) [the file we're appending to doesn't end with a new line.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=4&mode=live&start=49.26)

[Iterating over Files](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live)

[The culmination of these increasingly](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=1.04) [sophisticated text file reading tools is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=2.57) [the fact that file objects support the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=4.58) [iterator protocol, with each iteration](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=6.41) [yielding the next line in the file. This](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=8.56) [means that they can be used in for loops](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=10.9) [and any other place where an iterator can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=12.5) [be used. At this point, we'll take the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=14.16) [opportunity to create a Python module](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=16.26) [called files.py. We can call this directly](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=18.04) [from the system command line, passing the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=22.69) [name of our text file python3 files.py](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=24.39) [wasteland.txt. The double line spacing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=27.44) [occurs because each line of the poem is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=32.01) [terminated by a new line and then print](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=33.65) [adds its own. To fix that, we could use](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=35.66) [the strip method to remove the whitespace](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=37.98) [from the end of each line prior to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=39.71) [printing. Instead, we'll use the write](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=41.08) [method of the standard out stream. This is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=43.23) [exactly the same write method we used to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=45.57) [write to the file, and can be used because](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=47.43) [the stream is a file‑like object. We get](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=49.3) [hold of a reference to the standard out](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=52.18) [stream from the sys module. Replace print](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=53.69) [line with sys.stdout.write(line).](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=56.44) [Rerunning, we get the poem printed without](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=59.4) [extra blank lines. Now, alas, it's time to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=63.01) [move on from one of the most important](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=66.85) [poems of the 20th century to get to grips with context managers.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=5&mode=live&start=68.27)

[Closing Files with Finally](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live)

[For the next demonstration, we're going to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=1.04) [need a data file containing some numbers.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=2.64) [We'll write a sequence of numbers called](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=4.77) [Recaman sequence to a text file with one](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=6.17) [number per line. Recaman sequence itself](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=8.57) [isn't important to this exercise. We just](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=11.69) [needed a way of generating numeric data so](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=13.63) [we won't be explaining the sequence](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=15.8) [generator. Feel free to experiment,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=17.15) [though. The module contains a generator](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=18.97) [for yielding the Recaman numbers and a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=21.67) [function which writes the start of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=23.2) [sequence to file using the writelines](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=24.51) [method. A generator expression is used to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=26.45) [convert each number to a string and add a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=28.9) [new line. Enter tools.islice is used to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=30.66) [truncate the otherwise infinite sequence.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=33.21) [We'll write the first 1000 Recaman numbers](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=37.24) [to a file by executing the module, passing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=39.3) [the file name in series length as command](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=41.34) [line arguments. Python 3, recaman.py,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=43.08) [recaman.dat 1000. We'll now take a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=44.5675) [complimentary module, series.py, which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=50.51) [reads this data file back in. We simply](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=52.93) [read one line at a time from the open](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=56.06) [file, strip the new line with the call to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=57.65) [the strip string method, and convert it to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=59.51) [an integer. Running it from the command](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=61.57) [line, everything works as expected. Now](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=64.03) [let's deliberately create an exceptional](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=68.14) [situation. Open recaman.dat in a text](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=69.92) [editor and replace one of the numbers with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=72.76) [something that isn't a stringified](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=74.6) [integer. Save the file and rerun. The int](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=76.015) [constructor raises a value error, which is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=80.5375) [unhandled, and so the program terminates](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=82.08) [with a stack trace. One problem here is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=83.85) [that our f.close call was never executed.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=86.81) [To fix that, we can insert a try finally](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=90.64) [block, put a try before the open call,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=92.98) [indenting everything up to the close call,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=95.33) [then put a finally before the close call,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=97.53) [indenting that as well. Now the file will](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=99.64) [always be closed. Doing so opens up the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=102.75) [opportunity for another refactoring. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=106.4) [can replace the for loop with the list](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=108.52) [comprehension and return this list](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=110.01) [directly. Return open bracket, int of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=111.63) [line.strip for line in f, closed bracket.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=114.0175) [Even in this situation, close will be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=118.64) [called. The finally block is called however the try block is exited.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=6&mode=live&start=120.48)

[With-blocks](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live)

[Up to now, our examples have all followed](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=1.24) [a pattern, open a file, work with the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=2.97) [file, close the file. The close is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=5.07) [important because it informs the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=7.65) [underlying operating system that you're](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=9) [done working with the file. If you don't](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=10.47) [close a file when you're done with it,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=12.54) [it's possible to lose data. There may be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=14) [pending writes buffered up which might not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=16.43) [get written completely. Furthermore, if](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=18.2) [you're opening lots of files, your system](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=20.4) [may run out of resources. Since we always](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=22.12) [want to pair every open with a close, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=25.08) [want a mechanism that enforces that and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=27.06) [makes sure that it happens even if we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=28.74) [forget. This need for resource cleanup is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=30.2) [common enough that Python implements a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=33.14) [specific control flow structure called](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=34.68) [with‑blocks to support it. With‑blocks can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=36.53) [be used with any object which supports the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=39.12) [context‑manager protocol. And this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=41.03) [includes the file objects returned by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=42.92) [open. Exploiting the context‑manager](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=44.95) [nature of the file object and using the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=47.83) [with‑block, our read\_series function can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=49.61) [become open the file with a with‑block and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=51.5) [return the list comprehension. We no](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=53.9) [longer need to call close explicitly](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=55.98) [because the with construct will call it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=57.67) [for us when and by whatever means](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=59.45) [execution exits the block. Now we can go](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=61.35) [back and modify our Recaman's series](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=64.85) [writing program to use a with‑block too.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=66.375) [This, again, removes the need for the explicit close.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=7&mode=live&start=69.04)

[Moment of Zen](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=8&mode=live)

[Sugary syntax, thoughtlessness attained](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=8&mode=live&start=2.01) [through sweet fidelity. The with blocks in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=8&mode=live&start=5.54) [tax is so called syntactic sugar for a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=8&mode=live&start=9.06) [much more complex arrangement of try](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=8&mode=live&start=11.38) [except and try finally blocks. Few of us](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=8&mode=live&start=13.13) [would want our code to look this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=8&mode=live&start=16.44) [convoluted, but for it to be reliable,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=8&mode=live&start=17.66) [this is how it would need to look without](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=8&mode=live&start=20.12) [the with statement. Sugar may not be good](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=8&mode=live&start=21.76) [for your health, but can be very healthy for your code, Which do you prefer?](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=8&mode=live&start=23.94)

[Binary Files](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live)

[To demonstrate handling of binary files,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=1.19) [we need an interesting binary data format.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=3.295) [The BMP file format contains](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=5.6) [device‑independent bit maps, and it's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=7.35) [simple enough that we can make a BMP file](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=9.21) [writer from scratch in this session. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=11.17) [code will be placed in a module bmp.py and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=14.1) [is straightforward from a file‑handling](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=16.810000000000002) [point of view. For simplicity's sake, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=18.36) [have decided to deal with 8‑bit grayscale](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=20.61) [images, which have the nice property that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=22.57) [they're 1 byte per pixel. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=24.24) [write\_grayscale function accepts two](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=26.23) [arguments, the filename and a collection](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=27.93) [of pixels. As the docs string points out,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=29.98) [this collection should be a sequence of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=32.58) [iterable series of integers. A lists of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=34.04) [lists of int objects would do just fine.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=36.29) [Each int is a pixel value from 0 to 255.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=39.04) [Each inner list is a row of pixels from](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=42.09) [left to right, and the outer list is a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=43.92) [list of pixel rows from top to bottom. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=45.71) [first thing we do is figure out the size](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=48.99) [of the image by counting the number of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=50.56) [rows to get the height and the number of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=51.89) [items in the 0th row to get the width. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=53.49) [assume, but don't check, that all rows](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=56.09) [have the same length. In production code,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=57.894999999999996) [that's a check we'd want to make. Next, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=60.03) [opened the file for write in binary mode](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=62.89) [using the wb mode string. We don't specify](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=64.78) [an encoding. That makes no sense for raw](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=67.49) [binary files. Inside the with block, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=69.6) [start writing what is called the BMP](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=72.47) [Header, which begins the BMP format. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=74.15) [header must start with a so‑called magic](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=77.45) [byte sequence, BM, to identify it as a BMP](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=79.25) [file. We use the write method, and because](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=82.27) [the file was opened in binary mode, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=84.97) [must pass a bytes object. The next 4 bytes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=86.64) [should hold a 32‑bit integer containing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=90.18) [the file size. We don't know that yet. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=91.93) [could have computed it in advance, but](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=94.74) [we'll take a different approach of writing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=96.36) [a placeholder value for now, then](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=97.82) [returning to this point later to fill in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=99.36) [the details. To be able to come back to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=100.94) [this point, we use the tell method of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=103.04) [file object to give us the offset from the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=104.99) [beginning of the file for the file](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=106.86) [pointer. We'll store this in a variable,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=108.36) [which will act as a sort of bookmark. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=110.69) [write 4 0 bytes as the placeholder, using](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=112.96) [escape syntax to specify the 0s. The next](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=115.38) [2 pairs of bytes are unused, so we just](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=119.4) [write 0 bytes of them too. The next 4](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=121.31) [bytes are for another 32‑bit integer,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=124.27) [which should contain the offset in bytes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=126.05) [from the beginning of the file to the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=127.445) [start of the pixel data. We don't know](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=128.8) [that value yet either, so we'll store](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=130.91) [another bookmark using tell and write](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=132.8) [another 4‑byte placeholder. We'll return](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=134.57) [here shortly when we know more. The next](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=136.69) [section is called the Image Header. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=140.36) [first thing we have to do is write the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=142.4) [length of the image as a 32‑bit integer.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=143.84) [In our case, the header will always be 40](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=146.44) [bytes long. We just hardwire that as a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=148.45) [hexadecimal. Notice that the BMP format is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=151.27) [little‑endian. The least significant byte](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=154.01) [is written first. The next 4 bytes are the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=155.93) [image width as a little‑endian 32‑bit](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=159.74) [integer. We call a module scope](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=161.55) [implementation detail function here called](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=163.26) [\_int32\_to\_bytes, which converts an int](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=165.23) [object into a bytes object containing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=168.22) [exactly 4 bytes. We then use the same](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=169.96) [function again to deal with the image](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=172.43) [height. The remainder of the header is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=174.01) [essentially fixed for 8‑bit grayscale](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=176.95) [images, and the details aren't important](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=178.7) [here, except to note that the whole header](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=180.42) [does, in fact, total 40 bytes. Each pixel](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=182.02) [in an 8‑bit BMP image is an index into a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=185.82) [color table with 256 entries. Each entry](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=188.05) [is a 4‑byte BGR color. For grayscale](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=191.14) [images, we need to write 256 4‑byte gray](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=194.09) [values on a linear scale. This snippet is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=196.94) [fertile ground for experimentation, and a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=199.39) [natural enhancement to this function would](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=201.54) [be to be able to supply this pallet](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=203.39) [separately as a function argument. At](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=204.92) [last, we're ready to write the pixel data,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=207.58) [but before we do, we make a note of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=209.8) [current file pointer offset using tell as](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=211.69) [this was one of the locations we need to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=214.18) [go back and fill in later. Writing the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=215.7) [pixel data itself is straightforward](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=218.54) [enough. We use the reversed built‑in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=220.08) [function to flip the order of the rows.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=222.1) [BMP images are written bottom to top. For](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=224.175) [each row, we simply pass the iterable](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=227.34) [series of integers to the bytes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=228.76999999999998) [constructor. If any of the integers are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=230.37) [out of the range 0 to 255, the constructor](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=232.38) [will raise a value error. Each row of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=235.01) [pixel data in a BMP file must be a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=238.05) [multiple of 4 bytes long irrespective of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=240.01) [image width. To achieve this, we compute](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=242.16) [the number of padding bytes required by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=244.43) [subtracting the row length modulus 4 from](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=246.68) [4. This value is used with a repetition](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=248.17000000000002) [operator applied to a single 0 byte to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=251.25) [produce a bytes object containing 0, 1, 2,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=253.25) [or 3 bytes. We write this to the file to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=256.08) [terminate each row. After the pixel data,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=258.55) [we are at the end of the file. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=262.015) [undertook to record this offset value](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=263.53) [earlier, so we record the current position](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=265.22) [using tell into an end‑of‑file bookmark](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=267.12) [(end\_bookmark) variable. Now we can return](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=269.13) [in to fill our promises by replacing the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=271.43) [placeholder offsets we recorded with the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=273.16) [real values. First, the file length. To do](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=275.04) [this, we seek back to the size\_bookmark we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=278.23) [remembered back near the beginning of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=280.4) [file and write the size stored in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=281.87) [eof\_bookmark as a little‑endian, 32‑bit](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=283.81) [integer using our \_int32\_to\_bytes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=286.19) [function. Finally, we seek to the pixel](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=288.18) [data offset placeholder bookmarked by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=291.72) [pixel offset bookmark and write the 32‑bit](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=293.48) [integer stored in pixel\_data\_bookmark. As](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=295.9) [we exit the with block, we can rest](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=299.34) [assured that the context manager will](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=300.81) [close the file and commit any unbuffered writes to the file system.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=9&mode=live&start=302.24)

[Bitwise Operators](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=10&mode=live)

[Dealing with binary files often requires](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=10&mode=live&start=1.04) [pulling apart or assembling data at the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=10&mode=live&start=3.01) [byte level. This is exactly what our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=10&mode=live&start=4.68) [\_n32\_to\_bytes function is doing. We'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=10&mode=live&start=6.71) [take a quick look at it because it shows](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=10&mode=live&start=9.34) [some features of Python we haven't seen](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=10&mode=live&start=10.82) [before. The function uses the Right‑shift](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=10&mode=live&start=12.26) [and Bitwise‑and operators to extract](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=10&mode=live&start=16.05) [individual bites from the integer value.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=10&mode=live&start=18.04) [Note that Bitwise‑and uses the ampersand](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=10&mode=live&start=20.54) [symbol to distinguish it from the logical](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=10&mode=live&start=22.66) [and, which is the spelled out word and.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=10&mode=live&start=24.47) [The double arrow is the Right‑shift](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=10&mode=live&start=27.14) [operator, which shifts the binary](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=10&mode=live&start=28.69) [representation of the integer right by the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=10&mode=live&start=30.41) [specified number of bits. The routine](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=10&mode=live&start=32.37) [shifts the integer 1, 2, and 3 bytes to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=10&mode=live&start=34.75) [the right before extracting the least](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=10&mode=live&start=37.05) [significant byte with the Bitwise‑and at](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=10&mode=live&start=38.65) [each position. The 4 resulting integers](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=10&mode=live&start=40.74) [are used to construct a tuple, which is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=10&mode=live&start=43.33) [then passed to the bytes constructor to produce a 4‑bytes sequence.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=10&mode=live&start=45.01)

[Pixel Data](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live)

[In order to generate a BMP image file,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=1.09) [we're going to need some pixel data. We've](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=3.17) [provided a simple module, fractal.py,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=5.14) [which produces pixel values from the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=7.52) [iconic Mandelbrot set fractal. We're not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=9.1) [going to explain the fractal generation](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=11.94) [code in detail, still less the math behind](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=13.48) [it, but the code is simple enough and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=15.58) [doesn't rely on any Python features we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=17.15) [haven't encountered previously. The key](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=18.77) [takeaway is that the Mandelbrot function](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=21.57) [uses nested list comprehensions to produce](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=23.21) [a list of lists of integers in the range 0](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=25.23) [to 255, representing an image of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=27.355) [fractal. The integer value at each point](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=30.1) [is produced by the mandel function. Let's](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=31.95) [fire up a REPL and use the fractal and BMP](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=36.03) [modules together. First, we use the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=38.29) [Mandelbrot function to produce an image of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=40.33) [448 by 256 pixels. You'll get best results](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=42.12) [using images with an aspect ratio of 7 to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=46.06) [4. This last call may take a second or so.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=48.18) [Our fractal generator is simple rather](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=52.14) [than efficient. We can take a look at the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=53.86) [return to data structure, a list of lists](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=56.24) [of integers just as we were promised.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=58.8) [Let's write those pixel values to a BMP](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=61.04) [file, import bmp bmp.write\_grayscale](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=62.98) [("mandel.bmp", pixels). Find the file and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=66.6) [open it in an image viewer, for example, by opening it in your web browser.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=11&mode=live&start=70.96)

[Reading Binary Data](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live)

[We're not going to write a full‑blown BMP](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=1.04) [reader, although that would be an](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=2.87) [interesting exercise. We'll just make a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=3.96) [simple function to determine the image](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=5.96) [dimension in pixels from a BMP file. We'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=7.51) [add the code into bmp.py. Of course, we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=9.99) [can use a with statement to manage the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=14.24) [file so we don't have to worry about it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=15.45) [being properly closed. Inside the with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=16.93) [block, we perform a simple validation](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=19.04) [check by looking for the first two magic](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=20.7) [bytes that we expect in a BMP file. If](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=22.33) [they are not present, we raise a value](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=25.47) [error, which will, of course, caused the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=27.08) [context manager to close the file. Looking](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=28.85) [back at our BMP writer, we can determine](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=32.08) [that the image dimensions are stored](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=33.96) [exactly 18 bytes from the beginning of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=35.3) [file. We seek to that location and use the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=37.16) [read method to read two chunks of 4 bites](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=39.77) [each for the 2 32‑bit integers, which](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=42) [represent the dimensions. Because we](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=43.88) [opened the file in binary mode, read](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=45.92) [returns a bytes object. We pass each of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=47.72) [these two bytes objects to another](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=50.24) [implementation detailed called](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=51.72) [\_bytes\_to\_int32, which assembles them back](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=53.3) [into an integer. The two integers](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=56.26) [representing image width and height are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=58.52) [returned as a tuple. The \_bytes\_to\_int32](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=60.09) [function uses bitwise left shift and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=63.51) [bitwise or, which is the vertical bar or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=66.08) [pipe symbol, together with indexing of the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=67.96) [bytes object to reassemble the integer.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=70.09) [Note that indexing into a bytes object](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=72.53) [returns an integer. Let's use it, bmp.dimensions("mandel.bmp").](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=12&mode=live&start=74.51)

[File-like Objects](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live)

[There is a notion in Python of file‑like](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=1.04) [objects. This isn't as formal as a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=3.08) [specific protocol, like sequence protocol](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=4.94) [is for the tuple‑like objects, but thanks](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=7.02) [to the polymorphism afforded by duck](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=8.98) [typing, it works well in practice. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=10.59) [reason it's not closely specified is that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=13.27) [different types of data streams and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=15.08) [devices have many different capabilities,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=16.34) [expectations, and behaviors. So in fact,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=18.17) [defining a set of protocols to model them](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=20.45) [would be quite complex without actually](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=22.13) [gaining us much in practice, other than a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=24.1) [smug sense of theoretical achievement.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=25.92) [This is where the EAFP, easier to ask](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=27.875) [forgiveness than permission philosophy,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=30.76) [comes into its own. If you want to perform](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=32.17) [seek on a file‑like object without knowing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=34.41) [in advance that it supports random access,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=36.28) [go ahead and try, literally. But be](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=38.37) [prepared to fail if the seek method](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=40.42) [doesn't exist or does exist but doesn't](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=42.04) [behave as you expect. You might say, if it](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=43.93) [looks like a file and reads like a file,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=47.65) [then it's a file. We've actually seen this](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=49.325) [already. The objects returned to us when](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=51.92) [we open files and text in binary mode are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=53.97) [actually of different types, although both](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=56) [with definite file‑like behavior. There](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=57.69) [are other types in the Python standard](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=60.95) [library which implement file‑like](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=62.83) [behavior. We saw one of them in action](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=63.79) [back at the beginning of the course, used](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=65.68) [to retrieve data from a URL on the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=67.24) [internet. Let's exploit this polymorphism](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=68.93) [across file‑like objects by writing a](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=73.05) [function to count the number of words per](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=74.67) [line in a file and return that information](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=76.21) [as a list. We'll call it words\_per\_line,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=78.11) [accepting a single argument, flo. It'll](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=80.58) [return a list comprehension that takes the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=83.94) [length of line.split for each line in the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=85.62) [argument. Now we'll open a regular text](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=87.76) [file containing the fragment of T. S.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=90.33) [Eliot's masterpiece we created earlier,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=91.84) [with open, wasteland.txt, as real\_file.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=94.01) [And then we'll pass real\_file to our new](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=98.44) [function and display the results. The](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=100.36) [actual type of real\_file is](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=103.79) [\_io.TextIOWrapper, which is an internal](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=105.3) [Python implementation detail. We'll now do](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=108.27) [the same using a file‑like object](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=111.33) [representing a web resource referred to by](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=112.95) [a URL. First, we import urlopen from](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=114.99) [urllib.request. We then open the resource](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=118.19) [using](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=121.52) [urlopen("http://sixty‑north.com/c/t.txt")](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=121.76) [as web\_file. Count the words per line with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=125.275) [words\_per\_line of web\_file and display the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=130.17) [results. In this case, the type of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=132.9) [web\_file is http.client.HTTPResponse,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=136.18) [quite a different thing from what we saw](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=138.6125) [before. However, since both are file‑like](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=141.25) [objects, our function can work with both.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=144.19) [There's nothing magical about file‑like](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=146.84) [objects. It's just a convenient and fairly](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=148.43) [informal description for a set of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=150.45) [expectations we can place on an object which are exploited through duck typing.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=13&mode=live&start=151.85)

[Context Managers](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live)

[The with statement construct can be used](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=1.04) [with any type of object which implements](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=2.82) [the context Manager protocol. We're not](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=4.53) [going to show you how to implement that in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=6.66) [this course, but we will show you a simple](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=8.09) [way to make your own classes usable with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=10.09) [the context manager, using the code in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=11.73) [fridge.py. We'll import raid into the REPL](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=13.49) [and go on the rampage, from fridge import](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=18.21) [raid. Now we raid the fridge for bacon.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=20.79) [Importantly, we remembered to close the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=25.17) [door so the food will be preserved until](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=27.02) [our next raid. However, what if we raid](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=28.83) [the fridge for deep‑fried pizza? This time](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=31.41) [we were interrupted by a health warning](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=34.57) [and didn't get around to closing the door.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=36.26) [We can fix that by using a function called](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=38.44) [closing in the Python Standard Library](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=40.18) [contextlib module. After importing the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=41.71) [function, we wrap our RefrigeratorRaider](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=44.55) [constructor call in a call to closing,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=46.47) [which wraps our object in a context](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=48.48) [manager that always calls the close method](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=49.99) [on the wrapped object before exiting. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=52.05) [use this object to initialize a with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=54.64) [block. Now we execute a raid for Spam. We](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=56.41) [see that the close is called twice. Our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=60.55) [explicit call to close is unnecessary. So](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=62.61) [let's fix that up by removing the explicit](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=64.75) [call to close. A more sophisticated](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=66.59) [implementation, we check that the door was](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=68.89) [already closed and ignore other requests.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=70.4) [Now, if we ill‑advisedly raid for](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=73.48) [deep‑fried pizza, we see that even though](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=75.27) [the health warning was triggered, the door](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=77.4) [was still closed for us by the context manager.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=14&mode=live&start=78.95)

[Summary](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live)

[As you've seen, Python makes it easy to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=1.04) [work with files or indeed, any file like](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=2.89) [object at many different levels, from byte](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=5.15) [level manipulation to high‑level lines of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=7.390000000000001) [encoded text. And Python provides](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=9.31) [excellent tools for doing the bookkeeping](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=11.49) [associated with files and other kinds of](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=13.25) [resources. Used diligently, the tools and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=14.93) [techniques we've covered here will help](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=17.74) [ensure that you use files efficiently,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=19.11) [safely, and with predictable results. In](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=20.9) [this module, we've learned that files are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=23.7) [open using the built‑in open function,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=25.58) [which accepts a file mode to control,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=27.45) [read, write, append behavior, and whether](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=29.3) [the file is to be treated as raw binary or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=31.49) [encoded text data. For text data, you](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=33.59) [should specify a text encoding. Text files](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=36.55) [deal with string objects and perform](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=39.77) [universal newline translation and string](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=41.27) [encoding. Binary files deal with bytes](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=43.15) [objects with no newline translation or](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=45.91) [encoding. When writing files, it's our](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=47.86) [responsibility to provide newline](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=50.51) [characters for line breaks. Files should](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=52.03) [always be closed after use. Files provide](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=55.09) [various line‑oriented methods for reading](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=58.4) [and are also iterators, which yield line](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=60.52) [by line. Files are context managers, and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=62.49) [the with statement can be used with](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=65.57) [context managers to ensure that cleanup](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=66.82) [operations, such as closing files, are](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=68.56) [performed. The notion of file‑like objects](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=70.49) [is loosely defined, but very useful in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=73.46) [practice. Exercise EAFP to make the most](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=75.44) [of them. Context managers aren't](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=78.09) [restricted to file‑like objects. We can](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=80.58) [use tools in the context of standard](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=82.78) [library module, such as the closing](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=84.47) [wrapper, to create our own context](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=86.29) [managers. Along the way, we found that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=87.89) [help can be used on instances of objects,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=91.24) [not just types. Pythons supports bitwise](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=93.24) [operators and, or, and left and right](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=96.38) [shift. Well done on completing Core](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=98.71) [Python: Getting Started. It took you no](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=102.56) [small amount of effort to get here, but](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=104.69) [we're confident that your hard work will](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=106.35) [pay dividends when you start to use what](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=107.75) [you've learned. Python is a big language,](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=109.33) [and this course can really only hope to](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=111.78) [lay a foundation upon which you can start](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=113.23) [to build. We hope we've opened enough](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=114.98) [doors so that you can confidently and](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=116.78) [rapidly expand your Python knowledge. Look](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=118.47) [out for other core Python courses here on](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=121.41) [Pluralsight, which build on the knowledge](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=123.12) [you've gained here and which explain the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=124.7) [many other tools and abstractions provided](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=126.28) [by Python for managing complexity.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=128.14) [Remember to check out our Python Craftsman](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=130.5) [Book series, which covers these topics in](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=132.38) [written form. Specifically, you'll find](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=134.05) [these topics covered in The Python](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=136.18) [Apprentice, the first book in the trilogy.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=137.59) [We'll be back with more content for the](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=140.34) [ever growing Python language and library.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=142.05) [Please remember, though, that the most](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=144.21) [important characteristic of Python is that](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=145.66) [it's great fun to write Python software. Happy programming.](https://app.pluralsight.com/player?course=getting-started-python-core&author=austin-bingham&name=dfda8a9a-38d4-4454-ad0d-ef0c19e36496&clip=15&mode=live&start=147.49)