

# Module 1

# Course 7 : Automate Cybersecurity tasks with python



to Course 7

Hello, and welcome to Automate Cybersecurity Tasks with Python, the seventh course in the Google Cybersecurity Certificate. You're on an exciting journey!

By the end of this course, you will develop a greater understanding of computer programming in Python and how Python can be effectively used to automate security-related tasks. You will start with key foundational concepts in Python, including data types, variables, conditional statements, and iterative statements. You'll then develop functions in Python and work with string and list data in a variety of ways. Finally, you'll explore algorithms that involve importing and parsing files.

## Certificate program progress

The Google Cybersecurity Certificate program has eight courses. Automate Cybersecurity Tasks with Python is the seventh course.



1. [Foundations of Cybersecurity](#) — Explore the cybersecurity profession, including significant events that led to the development of the cybersecurity field and its continued importance to organizational operations. Learn about entry-level cybersecurity roles and responsibilities.
2. [Play It Safe: Manage Security Risks](#) — Identify how cybersecurity professionals use frameworks and controls to protect business operations, and explore common cybersecurity tools.
3. [Connect and Protect: Networks and Network Security](#) — Gain an understanding of network-level vulnerabilities and how to secure networks.
4. [Tools of the Trade: Linux and SQL](#) — Explore foundational computing skills, including communicating with the Linux operating system through the command line and querying databases with SQL.
5. [Assets, Threats, and Vulnerabilities](#) — Learn about the importance of security controls and developing a threat actor mindset to protect and defend an organization's assets from various threats, risks, and vulnerabilities.
6. [Sound the Alarm: Detection and Response](#) — Understand the incident response lifecycle and practice using tools to detect and respond to cybersecurity incidents.
7. [Automate Cybersecurity Tasks with Python](#) — (*current course*) Explore the Python programming language and write code to automate cybersecurity tasks.
8. [Put It to Work: Prepare for Cybersecurity Jobs](#) — Learn about incident classification, escalation, and ways to communicate with stakeholders. This course closes out the program with tips on how to engage with the cybersecurity community and an introduction to AI in cybersecurity.
9. [Accelerate Your Job Search with AI](#) — Gain practical job search strategies and learn how to leverage AI tools (like Gemini and NotebookLM) to uncover your

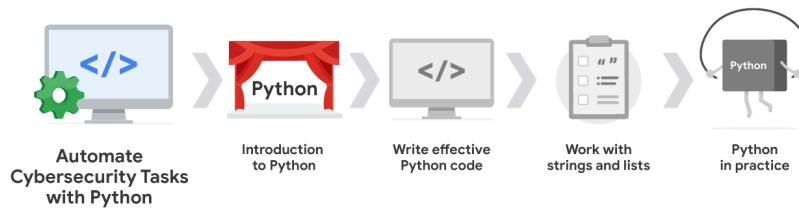
most valuable skills, create a job search plan, manage your applications, and practice for interviews as you navigate your path to your next role.

## Course 7 content

Each course of this certificate program is broken into modules. You can complete courses at your own pace, but the module breakdowns are designed to help you finish the entire Google Cybersecurity Certificate in about six months.

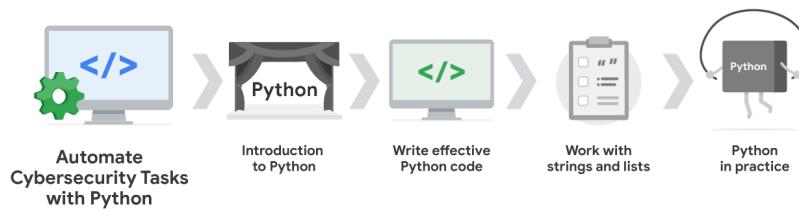
What's to come? Here's a quick overview of the skills you'll learn in each module of this course.

### Module 1: Introduction to Python



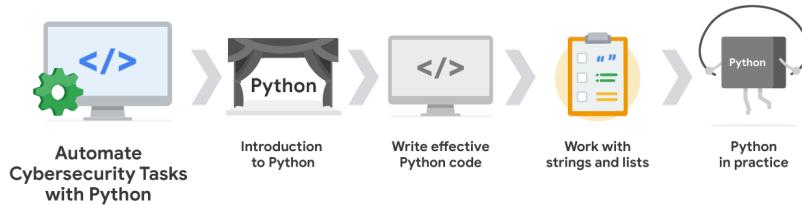
You will get an introduction to the Python programming language and how Python is used in cybersecurity. You'll also explore foundational Python concepts, including data types, variables, conditional statements, and iterative statements.

### Module 2: Write effective Python code



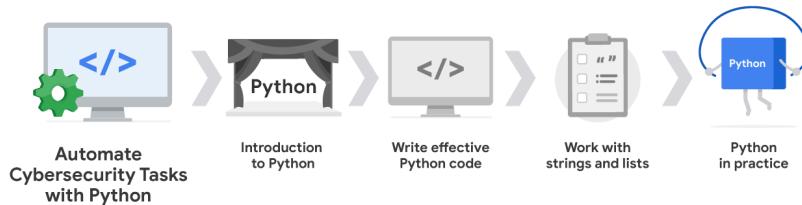
You will expand your ability to work with Python. You'll learn about prebuilt and user-defined Python functions. You'll also explore how modules help provide access to reusable code. Finally, you'll focus on code readability.

### Module 3: Work with strings and lists



You will learn more options for working with strings and lists in Python, and you will discover methods that can be applied to these data types. You'll apply this knowledge to write a short algorithm. Finally, you'll use regular expressions to search for patterns in strings.

### Module 4: Python in practice



You will put Python into practice and focus on automating cybersecurity-related tasks. You'll be introduced to opening and reading files. Then, you'll learn to parse files and structure their contents. Finally, you'll focus on strategies for debugging code.

## What to expect

Each course offers many types of learning opportunities:

- Videos led by Google instructors teach new concepts, introduce the use of relevant tools, offer career support, and provide inspirational personal stories.
- Readings build on the topics discussed in the videos, introduce related concepts, share useful resources, and describe case studies.
- Connect with other learners: If you have a question, chances are, you're not alone. Visit Coursera's private [Cybersecurity Community](#) to expand your network, discuss career journeys, and share experiences. Check out the [quick start guide](#).
- Self-review activities and labs give you hands-on practice in applying the skills you are learning and allow you to assess your own work by comparing it to a completed example.
- Interactive plug-ins encourage you to practice specific tasks and help you integrate knowledge you have gained in the course.
- In-video quizzes help you check your comprehension as you progress through each video.
- Practice quizzes allow you to check your understanding of key concepts and provide valuable feedback.
- Graded quizzes demonstrate your understanding of the main concepts of a course. You must score 80% or higher on each graded quiz to obtain a certificate, and you can take a graded quiz multiple times to achieve a passing score.

## Tips for success

- It is strongly recommended that you go through the items in each lesson in the order they appear because new information and concepts build on previous knowledge.
- Participate in all learning opportunities to gain as much knowledge and experience as possible.
- If something is confusing, don't hesitate to replay a video, review a reading, or repeat a self-review activity.

- Use the additional resources that are referenced in this course. They are designed to support your learning. You can find all of these resources in the [Resources](#) tab.
- When you encounter useful links in this course, bookmark them so you can refer to the information later for study or review.
- Understand and follow the [Coursera Code of Conduct](#) to ensure that the learning community remains a welcoming, friendly, and supportive place for all members.

# Helpful resources and tips

As a learner, you can choose to complete one or multiple courses in this program. However, to obtain the Google Cybersecurity Certificate, you must complete all the courses. This reading describes what is required to obtain a certificate and best practices for you to have a good learning experience on Coursera.

## Obtain the Google Cybersecurity Certificate

To receive your official Google Cybersecurity Certificate, you must:

- Pass all graded assignments in all 9 courses of the certificate program. Each graded assignment is part of a cumulative graded score for the course, and the passing grade for each course is 80%.

AND one of the following:

- Pay the [course certificate fee](#),
- Be approved for [Coursera Financial Aid](#), or
- Complete the certificate through an educational institution, employer, or agency that's sponsoring your participation.

## Healthy habits for course completion

Here is a list of best practices that will help you complete the courses in the program in a timely manner:

- Plan your time: Setting regular study times and following them each week can help you make learning a part of your routine. Use a calendar or timetable to create a schedule, and list what you plan to do each day in order to set achievable goals. Find a space that allows you to focus when you watch the videos, review the readings, and complete the activities.
- Work at your own pace: Everyone learns differently, so this program has been designed to let you work at your own pace. Although your personalized deadlines start when you enroll, feel free to move through the program at the speed that works best for you. There is no penalty for late assignments; to earn your certificate, all you have to do is complete all of the work. You can extend your deadlines at any time by going to Overview in the navigation panel and selecting Switch Sessions. If you have already missed previous deadlines, select Reset my deadlines instead.
- Be curious: If you find an idea that gets you excited, act on it! Enrich your learning experience with Gemini's [Guided Learning feature](#). It acts as your personal learning assistant, helping you ask insightful questions, find more details online, and explore interesting topics. The steps you take to support your learning along the way will advance your knowledge, create more opportunities in this high-growth field, and help you qualify for jobs.
- Take notes: Notes will help you remember important information in the future, especially as you're preparing to enter a new job field. In addition, taking notes is an effective way to make connections between topics and gain a better understanding of those topics.
- Review exemplars: Exemplars are completed assignments that fully meet an activity's criteria. Many activities in this program have exemplars for you to validate your work or check for errors. Although there are often many ways to

complete an assignment, exemplars offer guidance and inspiration about how to complete the activity.

- Build your career identity: Your career identity is the unique value you bring to the workforce. [Watch this video](#) to learn about the key components of career identity and write your own career identity statement. Discovering and defining your own career identity makes you better equipped to choose a career path that aligns with your strengths, values, and goals and is more effective in your chosen profession.
- Connect with other learners: If you have a question, chances are, you're not alone. Visit Coursera's private [Google Cybersecurity Community](#) to expand your network, discuss career journeys, and share experiences. Check out the [quick start guide](#).
- Update your profile: Consider [updating your profile](#) on Coursera with your photo, career goals, and more. When other learners find you in the Community, they can click on your name to access your profile and get to know you better.

## Documents, spreadsheets, presentations, and labs for course activities

To complete certain activities in the program, you will need to use digital documents, spreadsheets, presentations, and/or labs. Security professionals use these software tools to collaborate within their teams and organizations. If you need more information about using a particular tool, refer to these resources:

- [Microsoft Word: Help and learning](#): Microsoft Support page for Word
- [Google Docs](#): Help Center page for Google Docs
- [Microsoft Excel: Help and learning](#): Microsoft Support page for Excel
- [Google Sheets](#): Help Center page for Google Sheets
- [Microsoft PowerPoint: Help and learning](#): Microsoft Support page for PowerPoint
- [How to use Google Slides](#): Help Center page for Google Slides
- [Common problems with labs](#): Troubleshooting help for Qwiklabs activities

## Module, course, and certificate glossaries

This program covers a lot of terms and concepts, some of which you may already know and some of which may be unfamiliar to you. To review terms and help you prepare for graded quizzes, refer to the following glossaries:

- Module glossaries: At the end of each module's content, you can review a glossary of terms from that module. Each module's glossary builds upon the terms from the previous modules in that course. The module glossaries are not downloadable; however, all of the terms and definitions are included in the course and certificate glossaries, which are downloadable.
- Course glossaries: At the end of each course, you can access and download a glossary that covers all of the terms in that course.
- Certificate glossary: The certificate glossary includes all of the terms in the entire certificate program and is a helpful resource that you can reference throughout the program or at any time in the future.

You can access and download the certificate glossaries and save them on your computer. You can always find the course and certificate glossaries through the course's [Resources](#) section. To access the Cybersecurity Certificate glossary, click the link below and select *Use Template*.

- [Cybersecurity Certificate glossary](#)

OR

- If you don't have a Google account, you can download the glossary directly from the attachment below.

## Course feedback

Providing feedback on videos, readings, and other materials is easy. With the resource open in your browser, you can find the thumbs-up and thumbs-down symbols.

- Click thumbs-up for materials that are helpful.
- Click thumbs-down for materials that are not helpful.

If you want to flag a specific issue with an item, click the flag icon, select a category, and enter an explanation in the text box. This feedback goes back to the course development team and isn't visible to other learners. All feedback received helps to create even better certificate programs in the future.

For technical help, visit the [Learner Help Center](#).

# Get to know Python

In this reading, you will explore how programming works, how a computer processes the Python programming language, and how Python is used in cybersecurity.

## How programming works

Programming is a process that can be used to create a specific set of instructions for a computer to execute tasks. Computer programs exist everywhere. Computers, cell phones, and many other electronic devices are all given instructions by computer programs.

There are multiple programming languages used to create computer programs. Python is one of these. Programming languages are converted to binary numbers, which are a series of 0s and 1s that represent the operations that the computer's central processing unit (CPU) should perform. Each instruction corresponds to a specific operation, such as adding two numbers or loading a value from memory.

It would be very time-consuming for humans to communicate this way. Programming languages like Python make it easier to write code because you can use less syntax when instructing computers to perform complex processes.

## Using Python to program

Python is a general purpose programming language that can be used to solve a variety of problems. For example, it can be used to build websites, perform data analysis, and automate tasks.

Python code must be converted through an interpreter before the computer can process it. An interpreter is a computer program that translates Python code into runnable instructions line by line.

### Python versions

There are multiple versions of Python. In this course, you are using Python 3. While using Python, it's important to keep track of the version you're using. There are differences in the syntax of each version. Syntax refers to the rules that determine what is correctly structured in a computing language.

## Python in cybersecurity

In cybersecurity, Python is used especially for automation. Automation is the use of technology to reduce human and manual effort to perform common and repetitive tasks. These are some specific areas of cybersecurity in which Python might be used to automate specific tasks:

- Log analysis
- Malware analysis
- Access control list management
- Intrusion detection
- Compliance checks

- Network scanning

## Key takeaways

Python is a programming language, or in other words, a language used to create instructions for a computer to complete tasks. Programming languages are converted to binary numbers that a machine can understand. It's important to be aware that there are multiple versions of Python, and they have differences in syntax. Python is especially useful in cybersecurity for automating repetitive tasks.

# Python environments

You can run Python through a variety of environments. These environments include notebooks, integrated development environments (IDEs), and the command line. This reading will introduce you to these environments. It will focus primarily on notebooks because this is how you'll interact with Python in this course.

## Notebooks

One way to write Python code is through a notebook. In this course, you'll interact with Python through notebooks. A notebook is an online interface for writing, storing, and running code. They also allow you to document information about the code. Notebook content either appears in a code cell or markdown cell.

### Code cells

Code cells are meant for writing and running code. A notebook provides a mechanism for running these code cells. Often, this is a play button located within the cell. When you run the code, its output appears after the code.

## **Markdown cells**

Markdown cells are meant for describing the code. They allow you to format text in the markdown language. Markdown language is used for formatting plain text in text editors and code editors. For example, you might indicate that text should be in a certain header style.

## **Common notebook environments**

Two common notebook environments are [Jupyter Notebook](#) and [Google Colaboratory](#) (or Google Colab). They allow you to run several programming languages, including Python.

## **Integrated development environments (IDEs)**

Another option for writing Python code is through an integrated development environment (IDE), or a software application for writing code that provides editing assistance and error correction tools. Integrated development environments include a graphical user interface (GUI) that provides programmers with a variety of options to customize and build their programs.

## **Command line**

The command line is another environment that allows you to run Python programs. Previously, you learned that a command-line interface (CLI) is a text-based user interface that uses commands to interact with the computer. By entering commands into the command line, you can access all files and directories saved on your hard drive, including files containing Python code you want to run. You can also use the command line to open a file editor and create a new Python file.

## **Key takeaways**

Security analysts can access Python through a variety of environments, including notebooks, integrated development environments, and the command line. In this course, you'll use notebooks, which are online interfaces for interacting with code. Notebooks contain code cells for writing and running code as well as markdown cells for plain text descriptions.

# Lab tips and troubleshooting steps

Throughout this certificate you will use Qwiklabs and Jupyter Notebooks to complete hands-on activities that include Linux command line, packet capture, and Python programming tasks. In this reading, we will cover some tips and troubleshooting steps for using Qwiklabs and Jupyter Notebooks on your computer.

## Browser compatibility

Make sure your internet browser is updated regularly. Qwiklabs and Jupyter Notebooks require the latest version of Google Chrome, Firefox, Safari, or Microsoft Edge. If your browser is outdated or you are using a browser that is not supported by Qwiklabs or Jupyter Notebooks, you may encounter a problem. If your browser is up to date and you are using one of the browsers listed above and still encountering problems try restarting your browser or clearing your browser's cache and cookies. You can also use incognito mode which prevents your browser from storing cookies and other temporary data.

Note: The Qwiklabs user interface works best with Google Chrome.

## Internet connection

Qwiklabs and Jupyter Notebooks require a stable internet connection. If you are experiencing problems starting or completing Qwiklabs or Jupyter Notebooks, your internet connection may be slow or unreliable. Some signs of an unstable internet connection may be freezing labs, difficulty connecting to virtual machines, or the inability to type or enter commands within the lab environment.

Pro Tip: If you are unable to complete a Qwiklab or Jupyter Notebooks lab on one device, try using another device.

## Troubleshooting steps

To summarize, here are the troubleshooting steps to try if you encounter a problem with Qwiklabs or Jupyter Notebooks.

1. Make sure you are using the latest version of a supported browser: Google Chrome, Firefox, Safari, or Microsoft Edge.
2. Restart your browser and clear your browser's cache and cookies. You can also use incognito mode.

3. Check your internet connection and make sure it is stable. You can try restarting your router and modem to regain a stable connection.
4. Try restarting Qwiklabs or Jupyter Notebooks again.
5. For Qwiklabs only: If problems persist or you receive a message stating that you have exceeded the quota for a Qwiklab, submit this [form](#) to Qwiklabs support for assistance.

# Assign and reassign variables in Python

Previously, you've explored variables and how to assign and reassign them in Python. In this reading, you'll expand your understanding of these topics. You'll also learn about the general practice of naming variables so that you can avoid syntax errors and improve code readability.

## What are variables?

In a programming language, a variable is a container that stores data. It's a named storage location in a computer's memory that can hold a value. It stores the data in a particular data type, such as integer, string, or Boolean. The value that is stored in a variable can change.

You can think of variables as boxes with labels on them. Even when you change the contents of a box, the label on the box itself remains the same. Similarly, when you change the value stored in a variable, the name of the variable remains the same.

Security analysts working in Python will use a variety of variables. Some examples include variables for login attempts, allow lists, and addresses.

## Working with variables

In Python, it's important to know both how to assign variables and how to reassign them.

### Assigning and reassigning variables

If you want to create a variable called `username` and assign it a value of "nzhao", place the variable to the left of the equals sign and its value to the right:

```
# Assign 'username'  
  
username = "nzhao"
```

If you later reset this username to "zhaο2", you still refer to that variable container as `username`.

```
# Reassign 'username'  
  
username = "zhaο2"
```

Although the contents have changed from "nzhao" to "zhaο2", the variable `username` remains the same.

Note: You must place "nzhao" and "zhaο2" in quotation marks because they're strings. Python automatically assigns a variable its data type when it runs. For example, when the `username` variable contains the string "nzhao", it's assigned a string data type.

## Assigning variables to variables

Using a similar process, you can also assign variables to other variables. In the following example, the variable `username` is assigned to a new variable

```
old_username:
```

```
# Assign a variable to another variable
```

```
username = "nzhao"
```

```
old_username = username
```

Because `username` contains the string value of "nzhao" and `old_username` contains the value of `username`, `old_username` now contains a value of "nzhao".

## Putting it together

The following code demonstrates how a username can be updated. The `username` variable is assigned an initial value, which is then stored in a second variable called `old_username`. After this, the `username` variable is reassigned a new value. You can run this code to get a message about the previous username and the current username:

1

2

3

4

[Reset](#)

## Best practices for naming variables

You can name a variable almost anything you want, but there are a few guidelines you should follow to ensure correct syntax and prevent errors:

- Use only letters, numbers, and underscores in variable names. Valid examples:  
`date_3, username, interval2`
- Remember that variable names in Python are case-sensitive. These are all different variables: `time, Time, TIME, timE`.
- Don't use Python's built-in keywords or functions for variable names. For example, variables shouldn't be named `True, False, or if`.

Additionally, you should follow these stylistic guidelines to make your code easier for you and other security analysts to read and understand:

- Separate two or more words with underscores. Valid examples:  
`login_attempts, invalid_user, status_update`
- Avoid variables with similar names. These variables could be easily confused with one another: `start_time, starting_time, time_starting`.

- Avoid unnecessarily long names for variables. For instance, don't give variables names like `variable_that_equals_3`.
- Names should describe the data and not be random words. Valid examples:  
`num_login_attempts`, `device_id`, `invalid_usernames`

Note: Using underscores to separate multiple words in variables is recommended, but another convention that you might encounter is capitalizing the first letter of each word except the first word. Example: `LoginAttempt`

## Key takeaways

It's important for security analysts to have a fundamental understanding of variables. Variables are containers of data. They are assigned values and can also be reassigned other values or variables. It's helpful to remember the best practices for naming variables in order to create more functional, readable code.

# More on conditionals in Python

Previously, you explored conditional statements and how they're useful in automating tasks in Python. So far, you've focused on the `if` and `else` keywords. In this reading,

you'll review these and learn another keyword, `elif`. You'll also learn how you can apply the `and`, `or`, and `not` operators to your conditions.

## How conditional statements work

A conditional statement is a statement that evaluates code to determine whether it meets a specific set of conditions. When a condition is met, it evaluates to a Boolean value of `True` and performs specified actions. When the condition isn't met, it evaluates a Boolean value of `False` and doesn't perform the specified actions.

In conditional statements, the condition is often based on a comparison of two values. This table summarizes common comparison operators used to compare numerical values.

operator	use
>	greater than

<	less than
>=	greater than or equal to
<=	less than or equal to
==	equal to
!=	not equal to

Note: The equal to (==) and not equal to (!=) operators are also commonly used to compare string data.

## if statements

The keyword `if` starts a conditional statement. It's a necessary component of any conditional statement. In the following example, `if` begins a statement that tells Python to print an "OK" message when the HTTP response status code equals 200:

```
if status == 200:  
    print("OK")
```

This code consists of a header and a body.

### The header of an if statement

The first line of this code is the header. In the header of an `if` statement, the keyword `if` is followed by the condition. Here, the condition is that the `status` variable is equal to a value of `200`. The condition can be placed in parentheses:

```
if (status == 200):  
    print("OK")
```

In cases like this one, placing parentheses around conditions in Python is optional. You might want to include them if it helps you with code readability. However, this condition will be processed the same way if written without parentheses.

In other situations, because Python evaluates the conditions in parentheses first, parentheses can affect how Python processes conditions. You will read more about one of these in the section of this reading on `not`.

Note: You must always place a colon (:) at the end of the header. Without this syntax, the code will produce an error.

### The body of an if statement

After the header of an `if` statement comes the body of the `if` statement. This tells Python what action or actions to perform when the condition evaluates to `True`. In this example, there is just one action, printing "OK" to the screen. In other cases, there might be more lines of code with additional actions.

Note: For the body of the `if` statement to execute as intended, it must be indented further than the header. Additionally, if there are multiple lines of code within the body, they must all be indented consistently.

## Continuing conditionals with `else` and `elif`

In the previous example, if the HTTP status response code was not equal to `200`, the condition would evaluate to `False` and Python would continue with the rest of the program. However, it's also possible to specify alternative actions with `else` and `elif`.

## **else statements**

The keyword `else` precedes a code section that only evaluates when all conditions that precede it within the conditional statement evaluate to `False`.

In the following example, when the HTTP response status code is not equal to `200`, it prints an alternative message of "`check other status`".

```
if status == 200:  
    print("OK")  
  
else:  
    print("check other status")
```

Note: Like with `if`, a colon (`:`) is required after `else`, and the body that follows the `else` header is indented.

## elif statements

In some cases, you might have multiple alternative actions that depend on new conditions. In that case, you can use `elif`. The `elif` keyword precedes a condition that is only evaluated when previous conditions evaluate to `False`. Unlike with `else`, there can be multiple `elif` statements following `if`.

For example, you might want to print one message if the HTTP response status code is `200`, one message if it is `400`, and one if it is `500`. The following code demonstrates how you can use `elif` for this:

```
if status == 200:  
    print("OK")  
  
elif status == 400:  
    print("Bad Request")
```

```
elif status == 500:  
  
    print("Internal Server Error")
```

Python will first check if the value of `status` is `200`, and if this evaluates to `False`, it will go onto the first `elif` statement. There, it will check whether the value of `status` is `400`. If that evaluates to `True`, it will print `"Bad Request"`, but if it evaluates to `False`, it will go on to the next `elif` statement.

If you want the code to print another message when all conditions evaluate to `False`, then you can incorporate `else` after the last `elif`. In this example, if it reaches the `else` statement, it prints a message to check the status:

```
if status == 200:  
  
    print("OK")  
  
elif status == 400:  
  
    print("Bad Request")
```

```
elif status == 500:  
  
    print("Internal Server Error")  
  
else:  
  
    print("check other status")
```

Just like with `if` and `else`, it's important to place a colon (`:`) after the `elif` header and indent the code that follows this header.

Note: Python processes multiple `elif` statements differently than multiple `if` statements. When it reaches an `elif` statement that evaluates to `True`, it won't check the following `elif` statements. On the other hand, Python will run all `if` statements.

## Logical operators for multiple conditions

In some cases, you might want Python to perform an action based on a more complex condition. You might require two conditions to evaluate to `True`. Or, you might require only one of two conditions to evaluate to `True`. Or, you might want Python to perform an action when a condition evaluates to `False`. The operators `and`, `or`, and `not` can be used in these cases.

and

The `and` operator requires both conditions on either side of the operator to evaluate to `True`. For example, all HTTP status response codes between `200` and `226` relate to successful responses. You can use `and` to join a condition of being greater than or equal to `200` with another condition of being less than or equal to `226`:

```
if status >= 200 and status <= 226:  
    print("successful response")
```

When both conditions are `True`, then the `"successful response"` message will print.

or

The `or` operator requires only one of the conditions on either side of the operator to evaluate to `True`. For example, both a status code of `100` and a status code of `102` are informational responses. Using `or`, you could ask Python to print an `"informational response"` message when the code is either `100` or `102`:

```
if status == 100 or status == 102:
```

```
print("informational response")
```

Only one of these conditions needs to be met for Python to print the message.

**not**

The **not** operator negates a given condition so that it evaluates to **False** if the condition is **True** and to **True** if it is **False**. For example, if you want to indicate that Python should check the status code when it's something outside of the successful range, you can use **not**:

```
if not(status >= 200 and status <= 226):
```

```
    print("check status")
```

Python first checks whether the value of **status** is greater than or equal to **200** and less than or equal to **226**, and then because of the operator **not**, it inverts this. This means it will print the message if **status** is less than **200** or greater than **226**.

Note: In this case, the parentheses are necessary for the code to apply **not** to both conditions. Python will evaluate the conditions within the parentheses first. This means

it will first evaluate the conditions on either side of the `and` operator and then apply `not` to both of them.

## Key takeaways

It's important for security analysts to be familiar with conditional statements. Conditional statements require the `if` keyword. You can also use `else` and `elif` when working with conditionals to specify additional actions to take. The logical operators `and`, `or`, and `not` are also useful when writing conditionals.

# More on loops in Python

Previously, you explored iterative statements. An iterative statement is code that repeatedly executes a set of instructions. Depending on the criteria, iterative statements execute zero or more times. We iterated through code using both `for` loops and `while` loops. In this reading, you'll recap the syntax of loops. Then, you'll learn how to use the `break` and `continue` keywords to control the execution of loops.

## for loops

If you need to iterate through a specified sequence, you should use a `for` loop.

The following `for` loop iterates through a sequence of usernames. You can run it to observe the output:

1

2

[Reset](#)

The first line of this code is the loop header. In the loop header, the keyword `for` signals the beginning of a `for` loop. Directly after `for`, the loop variable appears. The loop variable is a variable that is used to control the iterations of a loop. In `for` loops, the loop variable is part of the header. In this example, the loop variable is `i`.

The rest of the loop header indicates the sequence to iterate through. The `in` operator appears before the sequence to tell Python to run the loop for every item in the sequence. In this example, the sequence is the list of usernames. The loop header must end with a colon (`:`).

The second line of this example `for` loop is the loop body. The body of the `for` loop might consist of multiple lines of code. In the body, you indicate what the loop should do with each iteration. In this case, it's to `print(i)`, or in other words, to display the

current value of the loop variable during that iteration of the loop. For Python to execute the code properly, the loop body must be indented further than the loop header.

Note: When used in a `for` loop, the `in` operator precedes the sequence that the `for` loop will iterate through. When used in a conditional statement, the `in` operator is used to evaluate whether an object is part of a sequence. The example `if "elarson" in ["tshah", "bmoreno", "elarson"]` evaluates to `True` because `"elarson"` is part of the sequence following `in`.

## Looping through a list

Using `for` loops in Python allows you to easily iterate through lists, such as a list of computer assets. In the following `for` loop, `asset` is the loop variable and another variable, `computer_assets`, is the sequence. The `computer_assets` variable stores a list. This means that on the first iteration the value of `asset` will be the first element in that list, and on the second iteration, the value of `asset` will be the second element in that list. You can run the code to observe what it outputs:

1

2

3

[Reset](#)

Note: It is also possible to loop through a string. This will return every character one by one. You can observe this by running the following code block that iterates through the string "security":

1

2

3

[Reset](#)

## Using `range()`

Another way to iterate through a `for` loop is based on a sequence of numbers, and this can be done with `range()`. The `range()` function generates a sequence of numbers. It accepts inputs for the start point, stop point, and increment in parentheses. For example, the following code indicates to start the sequence of numbers at 0, stop at 5, and increment each time by 1:

```
range(0, 5, 1)
```

Note: The start point is inclusive, meaning that 0 will be included in the sequence of numbers, but the stop point is exclusive, meaning that 5 will be excluded from the sequence. It will conclude one integer before the stopping point.

When you run this code, you can observe how 5 is excluded from the sequence:

1

2

[Reset](#)

You should be aware that it's always necessary to include the stop point, but if the start point is the default value of 0 and the increment is the default value of 1, they don't have to be specified in the code. If you run this code, you will get the same results:

1

2

[Reset](#)

Note: If the start point is anything other than `0` or the increment is anything other than `1`, they should be specified.

## while loops

If you want a loop to iterate based on a condition, you should use a `while` loop. As long as the condition is `True`, the loop continues, but when it evaluates to `False`, the `while` loop exits. The following `while` loop continues as long as the condition that `i < 5` is `True`:

1

2

3

4

[Reset](#)

In this `while` loop, the loop header is the line `while i < 5:`. Unlike with `for` loops, the value of a loop variable used to control the iterations is not assigned within the loop header in a `while` loop. Instead, it is assigned outside of the loop. In this example, `i` is assigned a starting value of `1` in a line preceding the loop.

The keyword `while` signals the beginning of a `while` loop. After this, the loop header indicates the condition that determines when the loop terminates. This condition uses the same comparison operators as conditional statements. Like in a `for` loop, the header of a `while` loop must end with a colon (`:`).

The body of a `while` loop indicates the actions to take with each iteration. In this example, it is to display the value of `i` and to increment the value of `i` by `1`. In order for the value of `i` to change with each iteration, it's necessary to indicate this in the body of the `while` loop. In this example, the loop iterates four times until it reaches a value of `5`.

## Integers in the loop condition

Often, as just demonstrated, the loop condition is based on integer values. For example, you might want to allow a user to log in as long as they've logged in less than five times. Then, your loop variable, `login_attempts`, can be initialized to `0`, incremented by `1` in the loop, and the loop condition can specify to iterate only when the variable is less than `5`. You can run the code below and review the count of each login attempt:

2

3

4

[Reset](#)

The value of `login_attempts` went from 0 to 4 before the loop condition evaluated to `False`. Therefore, the values of 0 through 4 print, and the value 5 does not print.

## Boolean values in the loop condition

Conditions in `while` loops can also depend on other data types, including comparisons of Boolean data. In Boolean data comparisons, your loop condition can check whether a loop variable equals a value like `True` or `False`. The loop iterates an indeterminate number of times until the Boolean condition is no longer `True`.

In the example below, a Boolean value is used to exit a loop when a user has made five login attempts. A variable called `count` keeps track of each login attempt and changes the `login_status` variable to `False` when the `count` equals 4. (Incrementing `count` from 0 to 4 represents five login attempts.) Because the `while` condition only iterates

when `login_status` is `True`, it will exit the loop. You can run this to explore this output:

1

2

3

4

5

6

7

[Reset](#)

The code prints a message to try again four times, but exits the loop once `login_status` is set to `False`.

## Managing loops

You can use the `break` and `continue` keywords to further control your loop iterations. Both are incorporated into a conditional statement within the body of the loop. They can be inserted to execute when the condition in an `if` statement is `True`. The `break` keyword is used to break out of a loop. The `continue` keyword is used to skip an iteration and continue with the next one.

### **break**

When you want to exit a `for` or `while` loop based on a particular condition in an `if` statement being `True`, you can write a conditional statement in the body of the loop and write the keyword `break` in the body of the conditional.

The following example demonstrates this. The conditional statement with `break` instructs Python to exit the `for` loop if the value of the loop variable `asset` is equal to `"desktop20"`. On the second iteration, this condition evaluates to `True`. You can run this code to observe this in the output:

1

2

3

4

5

[Reset](#)

As expected, the values of "desktop20" and "smartphone03" don't print because the loop breaks on the second iteration.

## **continue**

When you want to skip an iteration based on a certain condition in an `if` statement being `True`, you can add the keyword `continue` in the body of a conditional statement within the loop. In this example, `continue` will execute when the loop variable of `asset`

is equal to `"desktop20"`. You can run this code to observe how this output differs from the previous example with `break`:

1

2

3

4

5

[Reset](#)

The value `"desktop20"` in the second iteration doesn't print. However, in this case, the loop continues to the next iteration, and `"smartphone03"` is printed.

## Infinite loops

If you create a loop that doesn't exit, this is called an infinite loop. In these cases, you should press `CTRL-C` or `CTRL-Z` on your keyboard to stop the infinite loop. You might need to do this when running a service that constantly processes data, such as a web server.

## Key takeaways

Security analysts need to be familiar with iterative statements. They can use `for` loops to perform tasks that involve iterating through lists a predetermined number of times. They can also use `while` loops to perform tasks based on certain conditions evaluating to `True`. The `break` and `continue` keywords are used in iterative statements to control the flow of loops based on additional conditions.

# Reference guide: Python concepts from module 1

This reference guide contains Python language introduced during module 1. The guide is organized into the following sections:

- Comments
- Functions
- Conditional statements
- Iterative statements

Within each section, items generally appear in the order they were introduced.

## Access and save the guide

You can save a copy of this guide for future reference. You can use it as a resource for additional practice or in your future professional projects.

To access a downloadable version of this course item, click the following link and select *Use Template*.

[Reference guide: Python concepts from module 1](#)

OR

If you don't have a Google account, you can download the item directly from the following attachment:

# Glossary terms from module 1

## Terms and definitions from Course 7, Module 1

Automation: The use of technology to reduce human and manual effort to perform common and repetitive tasks

Boolean data: Data that can only be one of two values: either `True` or `False`

Command-line interface: A text-based user interface that uses commands to interact with the computer

Comment: A note programmers make about the intention behind their code

Conditional statement: A statement that evaluates code to determine if it meets a specified set of conditions

Data type: A category for a particular type of data item

Dictionary data: Data that consists of one or more key-value pairs

Float data: Data consisting of a number with a decimal point

Integer data: Data consisting of a number that does not include a decimal point

Integrated development environment (IDE): A software application for writing code that provides editing assistance and error correction tools

Interpreter: A computer program that translates Python code into runnable instructions line by line

Iterative statement: Code that repeatedly executes a set of instructions

List data: Data structure that consists of a collection of data in sequential form

Loop variable: A variable that is used to control the iterations of a loop

Notebook: An online interface for writing, storing, and running code

Programming: A process that can be used to create a specific set of instructions for a computer to execute tasks

Set data: Data that consists of an unordered collection of unique values

String data: Data consisting of an ordered sequence of characters

Syntax: The rules that determine what is correctly structured in a computing language

Tuple data: Data structure that consists of a collection of data that cannot be changed

Type error: An error that results from using the wrong data type

Variable: A container that stores data

# Module 2

# Python functions in cybersecurity

Previously, you explored how to define and call your own functions. In this reading, you'll revisit what you learned about functions and examine how functions can improve efficiency in a cybersecurity setting.

## Functions in cybersecurity

A function is a section of code that can be reused in a program. Functions are important in Python because they allow you to automate repetitive parts of your code. In cybersecurity, you will likely adopt some processes that you will often repeat.

When working with security logs, you will often encounter tasks that need to be repeated. For example, if you were responsible for finding malicious login activity based on failed login attempts, you might have to repeat the process for multiple logs.

To work around that, you could define a function that takes a log as its input and returns all potentially malicious logins. It would be easy to apply this function to different logs.

## Defining a function

In Python, you'll work with built-in functions and user-defined functions. Built-in functions are functions that exist within Python and can be called directly. The `print()` function is an example of a built-in function.

User-defined functions are functions that programmers design for their specific needs. To define a function, you need to include a function header and the body of your function.

### Function header

The function header is what tells Python that you are starting to define a function. For example, if you want to define a function that displays an "investigate activity" message, you can include this function header:

```
def display_investigation_message():
```

The `def` keyword is placed before a function name to define a function. In this case, the name of that function is `display_investigation_message`.

The parentheses that follow the name of the function and the colon (:) at the end of the function header are also essential parts of the syntax.

Pro tip: When naming a function, give it a name that indicates what it does. This will make it easier to remember when calling it later.

## Function body

The body of the function is an indented block of code after the function header that defines what the function does. The indentation is very important when writing a function because it separates the definition of a function from the rest of the code.

To add a body to your definition of the `display_investigation_message()` function, add an indented line with the `print()` function. Your function definition becomes the following:

```
def display_investigation_message():
    print("investigate activity")
```

## Calling a function

After defining a function, you can use it as many times as needed in your code. Using a function after defining it is referred to as calling a function. To call a function, write its name followed by parentheses. So, for the function you previously defined, you can use the following code to call it:

```
display_investigation_message()
```

Although you'll use functions in more complex ways as you expand your understanding, the following code provides an introduction to how the

`display_investigation_message()` function might be part of a larger section of code. You can run it and analyze its output:

1

2

3

4

5

6

7

8

9

10

11

12

[Reset](#)

The `display_investigation_message()` function is used twice within the code. It will print "investigate activity" messages about two different logs when the specified conditions evaluate to `True`. In this example, only the first conditional statement evaluates to `True`, so the message prints once.

This code calls the function from within conditionals, but you might call a function from a variety of locations within the code.

Note: Calling a function inside of the body of its function definition can create an infinite loop. This happens when it is not combined with logic that stops the function call when certain conditions are met. For example, in the following function definition, after you first call `func1()`, it will continue to call itself and create an infinite loop:

```
def func1():
    func1()
```

## Key takeaways

Python's functions are important when writing code. To define your own functions, you need the two essential components of the function header and the function body. After defining a function, you can call it when needed.

# Functions and variables

Previously, you focused on working with multiple parameters and arguments in functions and returning information from functions. In this reading, you'll review these concepts. You'll also be introduced to a new concept: global and local variables.

## Working with variables in functions

Working with variables in functions requires an understanding of both parameters and arguments. The terms parameters and arguments have distinct uses when referring to variables in a function. Additionally, if you want the function to return output, you should be familiar with return statements.

### Parameters

A parameter is an object that is included in a function definition for use in that function. When you define a function, you create variables in the function header. They can then be used in the body of the function. In this context, these variables are called parameters. For example, consider the following function:

```
def remaining_login_attempts(maximum_attempts, total_attempts):  
    print(maximum_attempts - total_attempts)
```

This function takes in two variables, `maximum_attempts` and `total_attempts` and uses them to perform a calculation. In this example, `maximum_attempts` and `total_attempts` are parameters.

## Arguments

In Python, an argument is the data brought into a function when it is called. When calling `remaining_login_attempts` in the following example, the integers `3` and `2` are considered arguments:

```
remaining_login_attempts(3, 2)
```

These integers pass into the function through the parameters that were identified when defining the function. In this case, those parameters would be `maximum_attempts` and `total_attempts`. `3` is in the first position, so it passes into `maximum_attempts`. Similarly, `2` is in the second position and passes into `total_attempts`.

## Return statements

When defining functions in Python, you use return statements if you want the function to return output. The `return` keyword is used to return information from a function.

The `return` keyword appears in front of the information that you want to return. In the following example, it is before the calculation of how many login attempts remain:

```
def remaining_login_attempts(maximum_attempts, total_attempts):  
    return maximum_attempts - total_attempts
```

Note: The `return` keyword is not a function, so you should not place parentheses after it.

Return statements are useful when you want to store what a function returns inside of a variable to use elsewhere in the code. For example, you might use this variable for calculations or within conditional statements. In the following example, the information returned from the call to `remaining_login_attempts` is stored in a variable called `remaining_attempts`. Then, this variable is used in a conditional that prints a "Your account is locked" message when `remaining_attempts` is less than or equal to 0. You can run this code to explore its output:

3

4

5

[Reset](#)

In this example, the message prints because the calculation in the function results in 0.

Note: When Python encounters a `return` statement, it executes this statement and then exits the function. If there are lines of code that follow the `return` statement within the function, they will not be run. The previous example didn't contain any lines of code after the `return` statement, but this might apply in other functions, such as one containing a conditional statement.

## Global and local variables

To better understand how functions interact with variables, you should know the difference between global and local variables.

When defining and calling functions, you're working with local variables, which are different from the variables you define outside the scope of a function.

## Global variables

A global variable is a variable that is available through the entire program. Global variables are assigned outside of a function definition. Whenever that variable is called, whether inside or outside a function, it will return the value it is assigned.

For example, you might assign the following variable at the beginning of your code:

```
device_id = "7ad2130bd"
```

Throughout the rest of your code, you will be able to access and modify the `device_id` variable in conditionals, loops, functions, and other syntax.

## Local variables

A local variable is a variable assigned within a function. These variables cannot be called or accessed outside of the body of a function. Local variables include parameters as well as other variables assigned within a function definition.

In the following function definition, `total_string` and `name` are local variables:

```
def greet_employee(name):  
    total_string = "Welcome" + name  
  
    return total_string
```

The variable `total_string` is a local variable because it's assigned inside of the function. The parameter `name` is a local variable because it is also created when the function is defined.

Whenever you call a function, Python creates these variables temporarily while the function is running and deletes them from memory after the function stops running.

This means that if you call the `greet_employee()` function with an argument and then use the `total_string` variable outside of this function, you'll get an error.

## Best practices for global and local variables

When working with variables and functions, it is very important to make sure that you only use a certain variable name once, even if one is defined globally and the other is defined locally.

When using global variables inside functions, functions can access the values of a global variable. You can run the following example to explore this:

1

2

3

4

[Reset](#)

The code block returns `"elarson"` even though that name isn't defined locally. The function accesses the global variable. If you wanted the `identify_user()` function to accommodate other usernames, you would have to reassign the global username variable outside of the function. This isn't good practice. A better way to pass different values into a function is to use a parameter instead of a global variable.

There's something else to consider too. If you reuse the name of a global variable within a function, it will create a new local variable with that name. In other words, there will be both a global variable with that name and a local variable with that name, and they'll have different values. You can consider the following code block:

1

2

3

4

5

6

7

[Reset](#)

The first print statement occurs before the function, and Python returns the value of the global `username` variable, "elarson". The second print statement is within the function, and it returns the value of the local `username` variable, which is "bmoreno". But this doesn't change the value of the global variable, and when `username` is printed a third time after the function call, it's still "elarson".

Due to this complexity, it's best to avoid combining global and local variables within functions.

## Key takeaways

Working with variables in functions requires understanding various concepts. A parameter is an object that is included in a function definition for use in that function, an argument is the data brought into a function when it is called, and the `return` keyword is used to return information from a function. Additionally, global variables are variables accessible throughout the program, and local variables are parameters and variables assigned within a function that aren't usable outside of a function. It's important to make sure your variables all have distinct names, even if one is a local variable and the other is a global variable.

# Work with built-in functions

Previously, you explored built-in functions in Python, including `print()`, `type()`, `max()`, and `sorted()`. Built-in functions are functions that exist within Python and can

be called directly. In this reading, you'll explore these further and also learn about the `min()` function. In addition, you'll review how to pass the output of one function into another function.

## print()

The `print()` function outputs a specified object to the screen. The `print()` function is one of the most commonly used functions in Python because it allows you to output any detail from your code.

To use the `print()` function, you pass the object you want to print as an argument to the function. The `print()` function takes in any number of arguments, separated by a comma, and prints all of them. For example, you can run the following code that prints a string, a variable, another string, and an integer together:

1

2

[Reset](#)

## type()

The `type()` function returns the data type of its argument. The `type()` function helps you keep track of the data types of variables to avoid errors throughout your code.

To use it, you pass the object as an argument, and it returns its data type. It only accepts one argument. For example, you could specify `type("security")` or `type(7)`.

## Passing one function into another

When working with functions, you often need to pass them through `print()` if you want to output the data type to the screen. This is the case when using a function like `type()`. Consider the following code:

1

[Reset](#)

It displays `str`, which means that the argument passed to the `type()` function is a string. This happens because the `type()` function is processed first and its output is passed as an argument to the `print()` function.

## **max() and min()**

The `max()` function returns the largest numeric input passed into it. The `min()` function returns the smallest numeric input passed into it.

The `max()` and `min()` functions accept arguments of either multiple numeric values or of an iterable like a list, and they return the largest or smallest value respectively.

In a cybersecurity context, you could use these functions to identify the longest or shortest session that a user logged in for. If a specific user logged in seven times during a week, and you stored their access times in minutes in a list, you can use the `max()` and `min()` functions to find and print their longest and shortest sessions:

1

2

3

[Reset](#)

## **sorted()**

The `sorted()` function sorts the components of a list. The `sorted()` function also works on any iterable, like a string, and returns the sorted elements in a list. By default, it sorts them in ascending order. When given an iterable that contains numbers, it sorts them from smallest to largest; this includes iterables that contain numeric data as well as iterables that contain string data beginning with numbers. An iterable that contains strings that begin with alphabetic characters will be sorted alphabetically.

The `sorted()` function takes an iterable, like a list or a string, as an input. So, for example, you can use the following code to sort the list of login sessions from shortest to longest:

1

2

[Reset](#)

This displays the sorted list.

The `sorted()` function does not change the iterable that it sorts. The following code illustrates this:

1

2

3

[Reset](#)

The first `print()` function displays the sorted list. However, the second `print()` function, which does not include the `sorted()` function, displays the list as assigned to `time_list` in the first line of code.

One more important detail about the `sorted()` function is that it cannot take lists or strings that have elements of more than one data type. For example, you can't use the list `[1, 2, "hello"]`.

## Key takeaways

Built-in functions are powerful tools in Python that allow you to perform tasks with one simple command. The `print()` function prints its arguments to the screen, the `type()` function returns the data type of its argument, the `min()` and `max()` functions return the smallest and largest values of an iterable respectively, and `sorted()` organizes its argument.

## Resources for more information

These were just a few of Python's built-in functions. You can continue learning about others on your own:

- [The Python Standard Library documentation](#): A list of Python's built-in functions and information on how to use them

# Import modules and libraries in Python

Previously, you explored libraries and modules. You learned that a module is a Python file that contains additional functions, variables, classes, and any kind of runnable code. You also learned that a library is a collection of modules that provide code users can access in their programs. You were introduced to a few modules in the Python Standard Library and a couple of external libraries. In this reading, you'll learn how to import a module that exists in the Python Standard Library and use its functions. You'll also expand your understanding of external libraries.

## The Python Standard Library

The Python Standard Library is an extensive collection of Python code that often comes packaged with Python. It includes a variety of modules, each with pre-built code centered around a particular type of task.

For example, you were previously introduced to the following modules in the Python Standard Library:

- The `re` module, which provides functions used for searching for patterns in log files
- The `csv` module, which provides functions used when working with `.csv` files
- The `glob` and `os` modules, which provide functions used when interacting with the command line
- The `time` and `datetime` modules, which provide functions used when working with timestamps

Another Python Standard Library module is `statistics`. The `statistics` module includes functions used when calculating statistics related to numeric data. For example, `mean()` is a function in the `statistics` module that takes numeric data as input and calculates its mean (or average). Additionally, `median()` is a function in the `statistics` module that takes numeric data as input and calculates its median (or middle value).

## How to import modules from the Python Standard Library

To access modules from the Python Standard Library, you need to import them. You can choose to either import a full module or to only import specific functions from a module.

### Importing an entire module

To import an entire Python Standard Library module, you use the `import` keyword. The `import` keyword searches for a module or library in a system and adds it to the local Python environment. After `import`, specify the name of the module to import. For

example, you can specify `import statistics` to import the `statistics` module. This will import all the functions inside of the `statistics` module for use later in your code.

As an example, you might want to use the `mean()` function from the `statistics` module to calculate the average number of failed login attempts per month for a particular user. In the following code block, the total number of failed login attempts for each of the twelve months is stored in a list called `monthly_failed_attempts`. Run this code and analyze how `mean()` can be used to calculate the average of these monthly failed login totals and store it in `mean_failed_attempts`:

1  
2  
3  
4

[Reset](#)

The output returns a mean of `35.25`. You might notice the outlying value of `178` and want to find the middle value as well. To do this through the `median()` function, you can use the following code:

1  
2  
3  
4

[Reset](#)

This gives you the value of `20.5`, which might also be useful for analyzing the user's failed login attempt statistics.

Note: When importing an entire Python Standard Library module, you need to identify the name of the module with the function when you call it. You can do this by placing the module name followed by a period (.) before the function name. For example, the previous code blocks use `statistics.mean()` and `statistics.median()` to call those functions.

## Importing specific functions from a module

To import a specific function from the Python Standard Library, you can use the `from` keyword. For example, if you want to import just the `median()` function from the `statistics` module, you can write `from statistics import median`.

To import multiple functions from a module, you can separate the functions you want to import with a comma. For instance, `from statistics import mean, median` imports both the `mean()` and the `median()` functions from the `statistics` module.

An important detail to note is that if you import specific functions from a module, you no longer have to specify the name of the module before those functions. You can examine this in the following code, which specifically imports only the `median()` and the `mean()` functions from the `statistics` module and performs the same calculations as the previous examples:

1

2

3

4

5

6

[Reset](#)

It is no longer necessary to specify `statistics.mean()` or `statistics.median()` and instead the code incorporates these functions as `mean()` and `median()`.

## External libraries

In addition to the Python Standard Library, you can also download external libraries and incorporate them into your Python code. For example, previously you were introduced to Beautiful Soup (`bs4`) for parsing HTML files and NumPy (`numpy`) for arrays and mathematical computations. Before using them in a Jupyter Notebook or a Google Colab environment, you need to install them first.

To install a library, such as `numpy`, in either environment, you can run the following line prior to importing the library:

```
%pip install numpy
```

This installs the library so you can use it in your notebook.

After a library is installed, you can import it directly into Python using the `import` keyword in a similar way to how you used it to import modules from the Python Standard Library. For example, after the `numpy` install, you can use this code to import it:

```
import numpy
```

## Key takeaways

The Python Standard Library contains many modules that you can import, including `re`, `csv`, `os`, `glob`, `time`, `datetime`, and `statistics`. To import these modules, you must use the `import` keyword. Syntax varies depending on whether or not you want to import the entire module or just specific functions from it. External libraries can also be imported into Python, but they need to be installed first.

# Ensure proper syntax and readability in Python

Previously, you were introduced to the PEP 8 style guide and its stylistic guidelines for programmers working in Python. You also learned about how adding comments and using correct indentation makes your code more readable. Additionally, correct indentation ensures your code is executed properly. This reading explores these ideas further and also focuses on common items to check in the syntax of your code to ensure it runs.

## Comments

A comment is a note programmers make about the intentions behind their code. Comments make it easier for you and other programmers to read and understand your code.

It's important to start your code with a comment that explains what the program does. Then, throughout the code, you should add additional comments about your intentions behind specific sections.

When adding comments, you can add both single-line comments and multi-line comments.

### Single-line comments

Single-line comments in Python begin with the (#) symbol. According to the PEP 8 style guide, it's best practice to keep all lines in Python under 79 characters to maintain readability, and this includes comments.

Single-line comments are often used throughout your program to explain the intention behind specific sections of code. For example, this might be when you're explaining simpler components of your program, such as the following `for` loop:

```
# Print elements of 'computer_assets' list

computer_assets = ["laptop1", "desktop20", "smartphone03"]

for asset in computer_assets:

    print(asset)
```

Note: Comments are important when writing more complex code, like functions, or multiple loops or conditional statements. However, they're optional when writing less complex code like reassigning a variable.

## Multi-line comments

Multi-line comments are used when you need more than 79 characters in a single comment. For example, this might occur when defining a function if the comment describes its inputs and their data types as well as its output.

There are two commonly used ways of writing multi-line comments in Python. The first is by using the hashtag (#) symbol over multiple lines:

```
# remaining_login_attempts() function takes two integer parameters,
# the maximum login attempts allowed and the total attempts made,
# and it returns an integer representing remaining login attempts

def remaining_login_attempts(maximum_attempts, total_attempts):

    return maximum_attempts - total_attempts
```

Another way of writing multi-line comments is by using documentation strings and not assigning them to a variable. Documentation strings, also called docstrings, are strings

that are written over multiple lines and are used to document code. To create a documentation string, use triple quotation marks (""""").

You could add the comment to the function in the previous example in this way too:

```
"""
remaining_login_attempts() function takes two integer parameters,
the maximum login attempts allowed and the total attempts made,
and it returns an integer representing remaining login attempts
"""

"""

remaining_login_attempts(max_attempts, total_attempts):
    """
    This function calculates the remaining login attempts.
    :param max_attempts: The maximum number of login attempts allowed.
    :param total_attempts: The total number of login attempts made so far.
    :return: An integer representing the remaining login attempts.
    """
    return max_attempts - total_attempts
```

## Correct indentation

Indentation is space added at the beginning of a line of code. In Python, you should indent the body of conditional statements, iterative statements, and function definitions. Indentation is not only necessary for Python to interpret this syntax properly, but it can also make it easier for you and other programmers to read your code.

The PEP 8 style guide recommends that indentations should be four spaces long. For example, if you had a conditional statement inside of a `while` loop, the body of the loop would be indented four spaces and the body of the conditional would be indented four spaces beyond that. This means the conditional would be indented eight spaces in total.

```
count = 0

login_status = True

while login_status == True:

    print("Try again.")

    count = count + 1
```

```
if count == 4:  
  
    login_status = False
```

## Maintaining correct syntax

Syntax errors involve invalid usage of the Python language. They are incredibly common with Python, so focusing on correct syntax is essential in ensuring that your code runs. Awareness of common errors will help you more easily fix them.

Syntax errors often occur because of mistakes with data types or in the headers of conditional or iterative statements or of function definitions.

### Data types

Correct syntax varies depending on data type:

- Place string data in quotation marks.
  - Example: `username = "bmoreno"`
- Do not add quotation marks around integer, float, or Boolean data types.
  - Examples: `login_attempts = 5, percentage_successful = .8,`  
`login_status = True`
- Place lists in brackets and separate the elements of a list with commas.
  - Example: `username_list = ["bmoreno", "tshah"]`

### Colons in headers

The header of a conditional or iterative statement or of a function definition must end with a colon. For example, a colon appears at the end of the header in the following function definition:

```
def remaining_login_attempts(maximum_attempts, total_attempts):  
  
    return maximum_attempts - total_attempts
```

## Key takeaways

The PEP 8 style guide provides recommendations for writing code that can be easily understood and read by other Python programmers. In order to make your intentions clear, you should incorporate comments into your code. Depending on the length of the comment, you can follow conventions for single-line or multi-line comments. It's also important to use correct indentation; this ensures your code will run as intended and also makes it easier to read. Finally, you should also be aware of common syntax issues so that you can more easily fix them.

## Resources for more information

Learning to write readable code can be challenging, so make sure to review the PEP 8 style guide and learn about additional aspects of code readability.

- [PEP 8 - Style Guide for Python Code](#): The PEP 8 style guide contains all standards of Python code. When reading this guide, it's helpful to use the table of contents to navigate through the concepts you haven't learned yet.

# Reference guide: Python concepts from module 2

This reference guide contains Python language introduced during module 2. The guide is organized into the following sections:

- User-defined functions
- Built-in functions
- Importing modules and libraries
- Comments

Within each section, items generally appear in the order they were introduced.

## **Access and save the guide**

You can save a copy of this guide for future reference. You can use it as a resource for additional practice or in your future professional projects.

To access a downloadable version of this course item, click the following link and select *Use Template*.

[Reference guide: Python concepts from module 2](#)

OR

If you don't have a Google account, you can download the item directly from the following attachment:

# **Glossary terms from module 2**

## **Terms and definitions from Course 7, Module 2**

Argument (Python): The data brought into a function when it is called

Built-in function: A function that exists within Python and can be called directly

Comment: A note programmers make about the intention behind their code

Function: A section of code that can be reused in a program

Global variable: A variable that is available through the entire program

Indentation: Space added at the beginning of a line of code

Library: A collection of modules that provide code users can access in their programs

Local variable: A variable assigned within a function

Module: A Python file that contains additional functions, variables, classes, and any kind of runnable code

Parameter (Python): An object that is included in a function definition for use in that function

PEP 8 style guide: A resource that provides stylistic guidelines for programmers working in Python

Python Standard Library: An extensive collection of Python code that often comes packaged with Python

Return statement: A Python statement that executes inside a function and sends information back to the function call

Style guide: A manual that informs the writing, formatting, and design of documents

User-defined function: A function that programmers design for their specific needs

# Module 3

# Strings and the security analyst

The ability to work with strings is important in the cybersecurity profession. Previously, you were introduced to several ways to work with strings, including functions and methods. You also learned how to extract elements in strings using bracket notation and indices. This reading reviews these concepts and explains more about using the `.index()` method. It also highlights examples of string data you might encounter in a security setting.

## String data in a security setting

As an analyst, string data is one of the most common data types you will encounter in Python. String data is data consisting of an ordered sequence of characters. It's used to store any type of information you don't need to manipulate mathematically (such as through division or subtraction). In a cybersecurity context, this includes IP addresses, usernames, URLs, and employee IDs.

You'll need to work with these strings in a variety of ways. For example, you might extract certain parts of an IP address, or you might verify whether usernames meet required criteria.

## Working with indices in strings

### Indices

An index is a number assigned to every element in a sequence that indicates its position. With strings, this means each character in the string has its own index.

Indices start at 0. For example, you might be working with this string containing a device ID: `"h32rb17"`. The following table indicates the index for each character in this string:

<b>character</b>	<b>index</b>
h	0
3	1
2	2
r	3
b	4
1	5
7	6

You can also use negative numbers as indices. This is based on their position relative to the last character in the string:

<b>character</b>	<b>index</b>
h	-7
3	-6

2		-5
r		-4
b		-3
1		-2
7		-1

## Bracket notation

Bracket notation refers to the indices placed in square brackets. You can use bracket notation to extract a part of a string. For example, the first character of the device ID might represent a certain characteristic of the device. If you want to extract it, you can use bracket notation for this:

```
"h32rb17" [0]
```

This device ID might also be stored within a variable called `device_id`. You can apply the same bracket notation to the variable:

```
device_id = "h32rb17"
```

```
device_id[0]
```

In both cases, bracket notation outputs the character `h` when this bracket notation is placed inside a `print()` function. You can observe this by running the following code:

2

3

[Reset](#)

You can also take a slice from a string. When you take a slice from a string, you extract more than one character from it. It's often done in cybersecurity contexts when you're only interested in a specific part of a string. For example, this might be certain numbers in an IP address or certain parts of a URL.

In the device ID example, you might need the first three characters to determine a particular quality of the device. To do this, you can take a slice of the string using bracket notation. You can run this line of code to observe that it outputs "h32":

1

[Reset](#)

Note: The slice starts at the 0 index, but the second index specified after the colon is excluded. This means the slice ends one position before index 3, which is at index 2.

## String functions and methods

The `str()` and `len()` functions are useful for working with strings. You can also apply methods to strings, including the `.upper()`, `.lower()`, and `.index()` methods. A method is a function that belongs to a specific data type.

### **str() and len()**

The `str()` function converts its input object into a string. As an analyst, you might use this in security logs when working with numerical IDs that aren't going to be used with mathematical processes. Converting an integer to a string gives you the ability to search through it and extract slices from it.

Consider the example of an employee ID `19329302` that you need to convert into a string. You can use the following line of code to convert it into a string and store it in a variable:

```
string_id = str(19329302)
```

The second function you learned for strings is the `len()` function, which returns the number of elements in an object.

As an example, if you want to verify that a certain device ID conforms to a standard of containing seven characters, you can use the `len()` function and a conditional. When you run the following code, it will print a message if `"h32rb17"` has seven characters:

1

2

3

[Reset](#)

### .upper() and .lower()

The `.upper()` method returns a copy of the string with all of its characters in uppercase. For example, you can change this department name to all uppercase by running the code `"Information Technology".upper()`. It would return the string `"INFORMATION TECHNOLOGY"`.

Meanwhile, the `.lower()` method returns a copy of the string in all lowercase characters. `"Information Technology".lower()` would return the string `"information technology"`.

### .index()

The `.index()` method finds the first occurrence of the input in a string and returns its location. For example, this code uses the `.index()` method to find the first occurrence of the character "r" in the device ID "h32rb17":

1

[Reset](#)

The `.index()` method returns 3 because the first occurrence of the character "r" is at index 3.

In other cases, the input may not be found. When this happens, Python returns an error. For instance, the code `print("h32rb17".index("a"))` returns an error because "a" is not in the string "h32rb17".

Also note that if a string contains more than one instance of a character, only the first one will be returned. For instance, the device ID "r45rt46" contains two instances of "r". You can run the following code to explore its output:

1

[Reset](#)

The output is 0 because `.index()` returns only the first instance of "r", which is at index 0. The instance of "r" at index 3 is not returned.

## Finding substrings with `.index()`

A substring is a continuous sequence of characters within a string. For example, "llo" is a substring of "hello".

The `.index()` method can also be used to find the index of the first occurrence of a substring. It returns the index of the first character in that substring. Consider this example that finds the first instance of the user "tshah" in a string:

1

Reset

The `.index()` method returns the index `7`, which is where the substring `"tshah"` starts.

Note: When using the `.index()` method to search for substrings, you need to be careful. In the previous example, you want to locate the instance of `"tshah"`. If you search for just `"ts"`, Python will return `0` instead of `7` because `"ts"` is also a substring of `"tsnow"`.

## Key takeaways

As a security analyst, you will work with strings in a variety of ways. First, you might need to use bracket notation to work with string indices. Two functions you will likely use are `str()`, which converts an input into a string, and `len()`, which finds the length of a string. You can also use string methods, functions that only work on strings. These include `.upper()`, which converts all letters in a string into uppercase letters, `.lower()`, which converts all letters in a string into lowercase letters, and `.index()`, which returns the index of the first occurrence of its input within a string.

# Lists and the security analyst

Previously, you examined how to use bracket notation to access and change elements in a list and some fundamental methods for working with lists. This reading will review these concepts with new examples, introduce the `.index()` method as it applies to lists, and highlight how lists are used in a cybersecurity context.

## List data in a security setting

As a security analyst, you'll frequently work with lists in Python. List data is a data structure that consists of a collection of data in sequential form. You can use lists to store multiple elements in a single variable. A single list can contain multiple data types.

In a cybersecurity context, lists might be used to store usernames, IP addresses, URLs, device IDs, and data.

Placing data within a list allows you to work with it in a variety of ways. For example, you might iterate through a list of device IDs using a `for` loop to perform the same actions for all items in the list. You could incorporate a conditional statement to only perform these actions if the device IDs meet certain conditions.

## Working with indices in lists

### Indices

Like strings, you can work with lists through their indices, and indices start at `0`. In a list, an index is assigned to every element in the list.

This table contains the index for each element in the list `["elarson", "fgarcia", "tshah", "sgilmore"]`:

element	index
<code>"elarson"</code>	<code>0</code>
<code>"fgarcia"</code>	<code>1</code>
<code>"tshah"</code>	<code>2</code>
<code>"sgilmore"</code>	<code>3</code>

## Bracket notation

Similar to strings, you can use bracket notation to extract elements or slices in a list. To extract an element from a list, after the list or the variable that contains a list, add square brackets that contain the index of the element. The following example extracts the element with an index of `2` from the variable `username_list` and prints it. You can run this code to examine what it outputs:

1

2

[Reset](#)

This example extracts the element at index `2` directly from the list:

1

[Reset](#)

## Extracting a slice from a list

Just like with strings, it's also possible to use bracket notation to take a slice from a list. With lists, this means extracting more than one element from the list.

When you extract a slice from a list, the result is another list. This extracted list is called a sublist because it is part of the original, larger list.

To extract a sublist using bracket notation, you need to include two indices. You can run the following code that takes a slice from a list and explore the sublist it returns:

1

2

[Reset](#)

The code returns a sublist of `["elarson", "fgarcia"]`. This is because the element at index 0, `"elarson"`, is included in the slice, but the element at index 2, `"tshah"`, is excluded. The slice ends one element before this index.

## Changing the elements in a list

Unlike strings, you can also use bracket notation to change elements in a list. This is because a string is immutable and cannot be changed after it is created and assigned a value, but lists are not immutable.

To change a list element, use similar syntax as you would use when reassigning a variable, but place the specific element to change in bracket notation after the variable name. For example, the following code changes the element at index **1** of the

`username_list` variable to `"bmoreno"`.

1

2

3

4

[Reset](#)

This code has updated the element at index **1** from `"fgarcia"` to `"bmoreno"`.

## List methods

List methods are functions that are specific to the list data type. These include the `.insert()`, `.remove()`, `.append()` and `.index()`.

### `.insert()`

The `.insert()` method adds an element in a specific position inside a list. It has two parameters. The first is the index where you will insert the new element, and the second is the element you want to insert.

You can run the following code to explore how this method can be used to insert a new username into a username list:

1

2

3

4

[Reset](#)

Because the first parameter is `2` and the second parameter is `"wjaffrey"`, `"wjaffrey"` is inserted at index `2`, which is the third position. The other list elements are shifted one position in the list. For example, `"tshah"` was originally located at index `2` and now is located at index `3`.

### **.remove()**

The `.remove()` method removes the first occurrence of a specific element in a list. It has only one parameter, the element you want to remove.

The following code removes `"elarson"` from the `username_list`:

1

2

3

4

[Reset](#)

This code removes "elarson" from the list. The elements that follow "elarson" are all shifted one position closer to the beginning of the list.

Note: If there are two of the same element in a list, the `.remove()` method only removes the first instance of that element and not all occurrences.

### **.append()**

The `.append()` method adds input to the end of a list. Its one parameter is the element you want to add to the end of the list.

For example, you could use `.append()` to add "btang" to the end of the `username_list`:

1

2

3

4

[Reset](#)

This code places "btang" at the end of the `username_list`, and all other elements remain in their original positions.

The `.append()` method is often used with `for` loops to populate an empty list with elements. You can explore how this works with the following code:

1

2

3

4

5

[Reset](#)

Before the `for` loop, the `numbers_list` variable does not contain any elements. When it is printed, the empty list is displayed. Then, the `for` loop iterates through a sequence of numbers and uses the `.append()` method to add each of these numbers to `numbers_list`. After the loop, when the `numbers_list` variable is printed, it displays these numbers.

## `.index()`

Similar to the `.index()` method used for strings, the `.index()` method used for lists finds the first occurrence of an element in a list and returns its index. It takes the element you're searching for as an input.

Note: Although it has the same name and use as the `.index()` method used for strings, the `.index()` method used for lists is not the same method. Methods are defined when defining a data type, and because strings and lists are defined differently, the methods are also different.

Using the `username_list` variable, you can use the `.index()` method to find the index of the username "tshah":

[Reset](#)

Because the index of "tshah" is 2, it outputs this number.

Similar to the `.index()` method used for strings, it only returns the index of the first occurrence of a list item. So if the username "tshah" were repeated twice, it would return the index of the first instance, and not the second.

## Key takeaways

Python offers a lot of ways to work with lists. Bracket notation allows you to extract elements and slices from lists and also to alter them. List methods allow you to alter lists in a variety of ways. The `.insert()` and `.append()` methods add elements to lists while the `.remove()` method allows you to remove them. The `.index()` method allows you to find the index of an element in a list.

# More about regular expressions

You were previously introduced to regular expressions and a couple of symbols that you can use to construct regular expression patterns. In this reading, you'll explore additional regular expression symbols that can be used in a cybersecurity context. You'll also learn more about the `re` module and its `re.findall()` function.

## Basics of regular expressions

A regular expression (regex) is a sequence of characters that forms a pattern. You can use these in Python to search for a variety of patterns. This could include IP addresses, emails, or device IDs.

To access regular expressions and related functions in Python, you need to import the `re` module first. You should use the following line of code to import the `re` module:

```
import re
```

Regular expressions are stored in Python as strings. Then, these strings are used in `re` module functions to search through other strings. There are many functions in the `re` module, but you will explore how regular expressions work through `re.findall()`. The `re.findall()` function returns a list of matches to a regular expression. It requires two parameters. The first is the string containing the regular expression pattern, and the second is the string you want to search through.

The patterns that comprise a regular expression consist of alphanumeric characters and special symbols. If a regular expression pattern consists only of alphanumeric characters, Python will review the specified string for matches to this pattern and return them. In the following example, the first parameter is a regular expression pattern consisting only of the alphanumeric characters "`ts`". The second parameter, "`tsnow, tshah, bmoreno`", is the string it will search through. You can run the following code to explore what it returns:

1

2

[Reset](#)

The output is a list of only two elements, the two matches to "`ts`": `['ts', 'ts']`.

If you want to do more than search for specific strings, you must incorporate special symbols into your regular expressions.

## Regular expression symbols

### Symbols for character types

You can use a variety of symbols to form a pattern for your regular expression. Some of these symbols identify a particular type of character. For example, `\w` matches with any alphanumeric character.

Note: The `\w` symbol also matches with the underscore (`_`).

You can run this code to explore what `re.findall()` returns when applying the regular expression of `"\w"` to the device ID of `"h32rb17"`.

1

2

[Reset](#)

Because every character within this device ID is an alphanumeric character, Python returns a list with seven elements. Each element represents one of the characters in the device ID.

You can use these additional symbols to match to specific kinds of characters:

- `.` matches to all characters, including symbols
- `\d` matches to all single digits [0-9]
- `\s` matches to all single spaces
- `\.` matches to the period character

The following code searches through the same device ID as the previous example but changes the regular expression pattern to "`\d`". When you run it, it will return a different list:

1

2

[Reset](#)

This time, the list contains only four elements. Each element is one of the numeric digits in the string.

### Symbols to quantify occurrences

Other symbols quantify the number of occurrences of a specific character in the pattern. In a regular expression pattern, you can add them after a character or a symbol

identifying a character type to specify the number of repetitions that match to the pattern.

For example, the `+` symbol represents one or more occurrences of a specific character.

In the following example, the pattern places it after the `\d` symbol to find matches to one or more occurrences of a single digit:

1

2

[Reset](#)

With the regular expression `"\d+"`, the list contains the two matches of `"32"` and `"17"`.

Another symbol used to quantify the number of occurrences is the `*` symbol. The `*` symbol represents zero, one, or more occurrences of a specific character. The following code substitutes the `*` symbol for the `+` used in the previous example. You can run it to examine the difference:

1

[Reset](#)

Because it also matches to zero occurrences, the list now contains empty strings for the characters that were not single digits.

If you want to indicate a specific number of repetitions to allow, you can place this number in curly brackets (`{ }`) after the character or symbol. In the following example, the regular expression pattern `"\d{2}"` instructs Python to return all matches of exactly two single digits in a row from a string of multiple device IDs:

[Reset](#)

Because it is matching to two repetitions, when Python encounters a single digit, it checks whether there is another one following it. If there is, Python adds the two digits to the list and goes on to the next digit. If there isn't, it proceeds to the next digit without adding the first digit to the list.

Note: Python scans strings left-to-right when matching against a regular expression. When Python finds a part of the string that matches the first expected character defined in the regular expression, it continues to compare the subsequent characters to the expected pattern. When the pattern is complete, it starts this process again. So in cases in which three digits appear in a row, it handles the third digit as a new starting digit.

You can also specify a range within the curly brackets by separating two numbers with a comma. The first number is the minimum number of repetitions and the second number is the maximum number of repetitions. The following example returns all matches that have between one and three repetitions of a single digit:

1

2

[Reset](#)

The returned list contains elements of one digit like "0", two digits like "32" and three digits like "825".

## Constructing a pattern

Constructing a regular expression requires you to break down the pattern you're searching for into smaller chunks and represent those chunks using the symbols you've learned. Consider an example of a string that contains multiple pieces of information about employees at an organization. For each employee, the following string contains their employee ID, their username followed by a colon (:), their attempted logins for the day, and their department:

```
employee_logins_string = "1001 bmoreno: 12 Marketing 1002 tshah: 7  
Human Resources 1003 sgilmore: 5 Finance"
```

Your task is to extract the username and the login attempts, without the employee's ID number or department.

To complete this task with regular expressions, you need to break down what you're searching for into smaller components. In this case, those components are the varying number of characters in a username, a colon, a space, and a varying number of single digits. The corresponding regular expression symbols are \w+, :, \s, and \d+ respectively. Using these symbols as your regular expression, you can run the following code to extract the strings:

[Reset](#)

Note: Working with regular expressions can carry the risk of returning unneeded information or excluding strings that you want to return. Therefore, it's useful to test your regular expressions.

## Key takeaways

Regular expressions allow you to search through strings to find matches to specific patterns. You can use regular expressions by importing the `re` module. This module contains multiple functions, including `re.findall()`, which returns all matches to a pattern in the form of a list. To form a pattern, you use characters and symbols. Symbols allow you to specify types of characters and to quantify how many repetitions of a character or type of character can occur in the pattern.

# Reference guide: Python concepts from module 3

This reference guide contains Python language introduced during module 3. The guide is organized into the following sections:

- Built-in functions
- String methods
- List methods
- Additional syntax for working with strings and lists
- Regular expressions

Within each section, items generally appear in the order they were introduced.

## **Access and save the guide**

You can save a copy of this guide for future reference. You can use it as a resource for additional practice or in your future professional projects.

To access a downloadable version of this course item, click the following link and select *Use Template*.

[Reference guide: Python concepts from module 3](#)

OR

If you don't have a Google account, you can download the item directly from the following attachment.

# **Glossary terms from module 3**

## **Terms and definitions from Course 7, Module 3**

Algorithm: A set of rules that solve a problem

Bracket notation: The indices placed in square brackets

Debugging: The practice of identifying and fixing errors in code

Immutable: An object that cannot be changed after it is created and assigned a value

Index: A number assigned to every element in a sequence that indicates its position

List concatenation: The concept of combining two lists into one by placing the elements of the second list directly after the elements of the first list

List data: Data structure that consists of a collection of data in sequential form

Method: A function that belongs to a specific data type

Regular expression (regex): A sequence of characters that forms a pattern

String concatenation: The process of joining two strings together

String data: Data consisting of an ordered sequence of characters

Substring: A continuous sequence of characters within a string

# Module 4

# Automating Tasks in CI/CD

## Automating Tasks in CI/CD: Using Python to Build Security Directly Into Your Pipeline

You've learned learned how important automation is for security and you've also seen how Python can automate security tasks. Now, let's explore how to use automation, and especially Python, to make your Continuous Integration and Continuous Delivery/Deployment (CI/CD) pipelines more secure.

Just like security analysts use Python to automate security tasks for whole systems, you can use Python to automate security tasks right inside your CI/CD pipeline. This means you build security checks directly into how you build and release software. This is called DevSecOps. Think of it as 'Development, Security, and Operations' working together from the beginning. DevSecOps is about making security a shared responsibility and automating security practices as part of your everyday workflow, ensuring that security is considered at every stage of your CI/CD pipeline.

Why Automate Security Tasks in CI/CD with Python?

Imagine manually checking every piece of code for problems, or manually testing every version of software for security issues before it's released. That would be really slow and have a lot of errors. Python is a great tool to automate these security tasks in CI/CD because it's flexible and has many helpful tools - like libraries.

Using Python to automate security tasks in your CI/CD pipeline is beneficial for a few reasons:

- Increases Speed and Efficiency: Python scripts for security checks are fast and work well as part of your pipeline. This keeps your software releases quick and secure at the same time.
- Finds Problems Early: Python can help find security problems early on when software is being developed. This makes problems easier and less expensive to fix.
- Remains Consistent: Python scripts make sure security checks are done the same way every time you build and release software. This lowers the chance of human error.
- Reduces workload for Security Teams: Python frees up security teams from repetitive tasks and allows them to work on larger security problems, planning, or creating better Python scripts for security automation.
- Supports a culture of security: Python-based automation helps put security into the CI/CD process. This helps create a DevSecOps culture where everyone thinks about security, not just the security team.

## What Security Tasks Can You Automate in CI/CD with Python?

You can use Python to automate many kinds of security tasks in CI/CD pipelines. Here are some main tasks:

## **Security Testing**

- Static Application Security Testing (SAST): Python scripts can be written to start SAST tools that look at your code for weaknesses *before* it gets built. Python can also be used to understand the SAST results, create reports, and automatically stop the process if serious security problems are found.
- Dynamic Application Security Testing (DAST): Python can be used to automatically run DAST tools to test software while it's running in a test area. Then, Python scripts can look at the DAST results and give feedback in the CI/CD pipeline.
- Software Composition Analysis (SCA): Python can work with SCA tools to check your software's dependencies for weaknesses. Dependencies are things like open source code and components from other companies. Scripts can control the SCA process, report problems, and set rules based on the severity of weaknesses.

## **Automated Vulnerability Scanning**

Python scripts can organize vulnerability scans of things like container images, infrastructure settings, and the CI/CD pipeline itself. You can use Python to schedule these scans, collect the results, and send alerts when new vulnerabilities are discovered.

## **Compliance Checks**

Python scripts can automatically check for compliance. For example, scripts can check if code follows secure coding rules or if infrastructure settings meet security guidelines. You can then use Python to make reports about compliance and ensure security standards are followed.

## **Secrets Management Automation**

Python is key for automating secure secrets management. Scripts can be used to review through code and stop private credentials from being directly written in the code. Also, Python scripts can work with secret management tools (like HashiCorp Vault) to safely get and put secrets into applications during automated releases.

## **Policy Enforcement**

"Policy as Code" and Python scripts work together to automatically enforce security policies. Python can be used to define and understand security policies. Then, scripts can check pipeline steps against these policies. If policies are broken (for example, if too many vulnerabilities are found), Python can automatically stop releases.

## **How Python Works with CI/CD Tools**

Python is even more helpful for CI/CD security automation because it works well with popular CI/CD tools. Tools like Jenkins, GitLab CI, and CircleCI let you easily run Python scripts as part of your release process.

Here's how Python fits in:

- Run Scripts: CI/CD systems let you set up release steps that run commands or scripts. You can easily set up steps to run Python scripts that do security tasks.
- API Connections: Many CI/CD tools and security tools have APIs (Application Programming Interfaces). Python is excellent at using APIs. You can write Python scripts to use CI/CD system APIs to manage the release process, start jobs, get software build files, and connect to security tool APIs to start scans and get results.
- Add-ons and Extensions: Some CI/CD systems have add-ons or extensions made in Python or that can easily use Python scripts. This makes it even simpler to add security automation based on Python.

## **Using Python to Set Up Environments, Check Code Quality, and Secure Releases**

Besides security testing, Python scripts can automate other important CI/CD tasks while adding security best practices:

- Set Up Environments: Python can automate staging areas. Scripts can make sure these areas are set up securely, with good network settings and security controls.
- Code Quality Checks: Python can be used to run code quality tools (linters). Scripts can check code for style problems and possible security errors. This helps make sure code quality standards are followed early in development.
- Automate Secure Releases: Python scripts are very useful for automating releases to staging and production areas securely. Python can manage release processes and ensure releases follow security best practices. This includes using secure settings and moving software files securely.

## **Conclusion: Python - Your Automation Ally for Secure CI/CD**

Using Python to automate security tasks is key to making your CI/CD pipeline secure and fast. By using Python's abilities and connecting it to your CI/CD tools, you can find and fix security problems early, do less manual work, enforce security rules, and make your software more secure overall.

By making Python automation a main part of your CI/CD security plan, you'll be ready to create and release secure software, quickly and with confidence. Now you know *how* Python helps automate security in CI/CD. Next, you'll learn about the specific parts of Python that make this possible. You'll learn about variables, conditional statements, iterative statements, functions, and working with files. These are the basic pieces for creating your own powerful Python scripts to automate security in CI/CD.

## Key Takeaways

Automating security in your CI/CD pipeline is now something you must do, not just something nice to have. DevSecOps means security should be built in, not added later. Python is a very helpful tool for this. It lets you automate important security tasks all through your software release process. By using Python for automation, you'll get a CI/CD pipeline that's faster, works better, and is much more secure, so you can release strong, secure software right from the start.

### Resources:

1. Best Python Libraries for Cybersecurity in 2024.  
[https://medium.com/@Scofield\\_Idelen/best-python-libraries-for-cybersecurity-in-2024-037a870f39d1](https://medium.com/@Scofield_Idelen/best-python-libraries-for-cybersecurity-in-2024-037a870f39d1)
2. Vulnerability Scanning for Secure Python Development. <https://safetycli.com/>
3. Article 3 - OWASP Dependency-Check and Vulnerability Scanning.  
<https://www.linkedin.com/pulse/article-3-owasp-dependency-check-vulnerability-scanning-adorsys-p73fe>
4. Python library for Hashicorp Vault implementation.  
<https://discuss.hashicorp.com/t/python-library-for-hashicorp-vault-implementation/55805>
5. Continuous Integration With Python: An Introduction.  
<https://realpython.com/python-continuous-integration/>
6. Python for DevOps: An Ultimate Guide. <https://code-b.dev/blog/python-devops>
7. Building Custom Cybersecurity Tools with Python: A Guide for Beginners.  
<https://www.linkedin.com/pulse/building-custom-cybersecurity-tools-python-bi6if>

8. Secure Coding in Python: Essential Practices for Data Engineers.

<https://www.linkedin.com/pulse/secure-coding-python-essential-practices-data-engineers-priyanka-sain-wewkc>

# Essential Python components for automation

Throughout this course, you explored coding in Python. You've focused on variables, conditional statements, iterative statements, functions, and a variety of ways to work with strings and lists. In this reading, you will explore why these are all essential components when automating tasks through Python, and you'll be introduced to another necessary component: working with files.

## Automating tasks in Python

Automation is the use of technology to reduce human and manual effort to perform common and repetitive tasks. As a security analyst, you will primarily use Python to automate tasks.

You have encountered multiple examples of how to use Python for automation in this course, including investigating logins, managing access, and updating devices.

Automating cybersecurity-related tasks requires understanding the following Python components that you've worked with in this course:

## **Variables**

A variable is a container that stores data. Variables are essential for automation. Without them, you would have to individually rewrite values for each action you took in Python.

## **Conditional statements**

A conditional statement is a statement that evaluates code to determine if it meets a specified set of conditions. Conditional statements allow you to check for conditions before performing actions. This is much more efficient than manually evaluating whether to apply an action to each separate piece of data.

## **Iterative statements**

An iterative statement is code that repeatedly executes a set of instructions. You explored two kinds of iterative statements: `for` loops and `while` loops. In both cases, they allow you to perform the same actions a certain number of times without the need to retype the same code each time. Using a `for` loop allows you to automate repetition

of that code based on a sequence, and using a `while` loop allows you to automate the repetition based on a condition.

## Functions

A function is a section of code that can be reused in a program. Functions help you automate your tasks by reducing the need to incorporate the same code multiple places in a program. Instead, you can define the function once and call it wherever you need it.

You can develop your own functions based on your particular needs. You can also incorporate the built-in functions that exist directly in Python without needing to manually code them.

## Techniques for working with strings

String data is one of the most common data types that you'll encounter when automating cybersecurity tasks through Python, and there are a lot of techniques that make working with strings efficient. You can use bracket notation to access characters in a string through their indices. You can also use a variety of functions and methods when working with strings, including `str()`, `len()`, and `.index()`.

## Techniques for working with lists

List data is another common data type. Like with strings, you can use bracket notation to access a list element through its index. Several methods also help you with automation when working with lists. These include `.insert()`, `.remove()`, `.append()`, and `.index()`.

### Example: Counting logins made by a flagged user

As one example, you may find that you need to investigate the logins of a specific user who has been flagged for unusual activity. Specifically, you are responsible for counting how many times this user has logged in for the day. If you are given a list identifying the username associated with each login attempt made that day, you can automate this investigation in Python.

To automate the investigation, you'll need to incorporate the following Python components:

- A `for` loop will allow you to iterate through all the usernames in the list.
- Within the `for` loop, you should incorporate a conditional statement to examine whether each username in the list matches the username of the flagged user.
- When the condition evaluates to `True`, you also need to increment a counter variable that keeps track of the number of times the flagged user appears in the list.

Additionally, if you want to reuse this code multiple times, you can incorporate it into a function. The function can include parameters that accept the username of the flagged user and the list to iterate through. (The list would contain the usernames associated with all login attempts made that day.) The function can use the counter variable to return the number of logins for that flagged user.

## Working with files in Python

One additional component of automating cybersecurity-related tasks in Python is understanding how to work with files. Security-related data will often be initially found in log files. A log is a record of events that occur within an organization's systems. In logs, lines are often appended to the record as time progresses.

Two common file formats for security logs are `.txt` files and `.csv` files. Both `.txt` and `.csv` files are types of text files, meaning they contain only plain text. They do not contain images and do not specify graphical properties of the text, including font, color, or spacing. In a `.csv` file, or a "comma-separated values" file, the values are separated by commas. In a `.txt` file, there is not a specific format for separating values, and they may be separated in a variety of ways, including spaces.

You can easily extract data from `.txt` and `.csv` files. You can also convert both into other file formats.

Coming up, you'll learn how to import, read from, and write to files. You will also explore how to structure the information contained in files.

## **Key takeaways**

It is important for security analysts to be able to automate tasks in Python. This requires knowledge of fundamental Python concepts, including variables, conditional statements, iterative statements, and techniques for working with strings and lists. In addition, the ability to work with files is also essential for automation in Python.

# **Import files into Python**

Previously, you explored how to open files in Python, convert them into strings, and read them. In this reading, you'll review the syntax needed for this. You'll also focus on why the ability to work with files is important for security analysts using Python, and you will learn about writing files.

## **Working with files in cybersecurity**

Security analysts may need to access a variety of files when working in Python. Many of these files will be logs. A log is a record of events that occur within an organization's systems.

For instance, there may be a log containing information on login attempts. This might be used to identify unusual activity that signals attempts made by a malicious actor to access the system.

As another example, malicious actors that have breached the system might be capable of attacking software applications. An analyst might need to access a log that contains information on software applications that are experiencing issues.

## Opening files in Python

To open a file called "`update_log.txt`" in Python for purposes of reading it, you can incorporate the following line of code:

```
with open("update_log.txt", "r") as file:
```

This line consists of the `with` keyword, the `open()` function with its two parameters, and the `as` keyword followed by a variable name. You must place a colon (`:`) at the end of the line.

## **with**

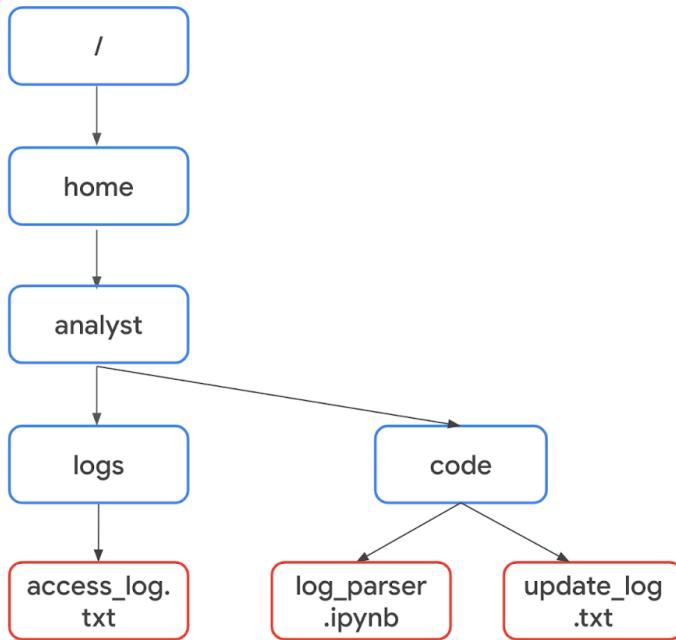
The keyword `with` handles errors and manages external resources when used with other functions. In this case, it's used with the `open()` function in order to open a file. It will then manage the resources by closing the file after exiting the `with` statement.

Note: You can also use the `open()` function without the `with` keyword. However, you should close the file you opened to ensure proper handling of the file.

## **open()**

The `open()` function opens a file in Python.

The first parameter identifies the file you want to open. In the following file structure, `"update_log.txt"` is located in the same directory as the Python file that will access it, `"log_parser.ipynb"`:



Because they're in the same directory, only the name of the file is required. The code can be written as `with open("update_log.txt", "r") as file:`.

However, `"access_log.txt"` is not in the same directory as the Python file `"log_parser.ipynb"`. Therefore, it's necessary to specify its absolute file path. A file path is the location of a file or directory. An absolute file path starts from the highest-level directory, the root. In the following code, the first parameter of the `open()` function includes the absolute file path to `"access_log.txt"`:

```
with open("/home/analyst/logs/access_log.txt", "r") as file:
```

Note: In Python, the names of files or their file paths can be handled as string data, and like all string data, you must place them in quotation marks.

The second parameter of the `open()` function indicates what you want to do with the file. In both of these examples, the second parameter is "`r`", which indicates that you want to read the file. Alternatively, you can use "`w`" if you want to write to a file or "`a`" if you want to append to a file.

`as`

When you open a file using `with open()`, you must provide a variable that can store the file while you are within the `with` statement. You can do this through the keyword `as` followed by this variable name. The keyword `as` assigns a variable that references another object. The code `with open("update_log.txt", "r") as file:` assigns `file` to reference the output of the `open()` function within the indented code block that follows it.

## Reading files in Python

After you use the code `with open("update_log.txt", "r") as file:` to import `"update_log.txt"` into the `file` variable, you should indicate what to do with the file on the indented lines that follow it. For example, this code uses the `.read()` method to read the contents of the file:

```
with open("update_log.txt", "r") as file:
```

```
updates = file.read()  
  
print(updates)
```

The `.read()` method converts files into strings. This is necessary in order to use and display the contents of the file that was read.

In this example, the `file` variable is used to generate a string of the file contents through `.read()`. This string is then stored in another variable called `updates`. After this, `print(updates)` displays the string.

Once the file is read into the `updates` string, you can perform the same operations on it that you might perform with any other string. For example, you could use the `.index()` method to return the index where a certain character or substring appears. Or, you could use `len()` to return the length of this string.

## Writing files in Python

Security analysts may also need to write to files. This could happen for a variety of reasons. For example, they might need to create a file containing the approved usernames on a new allow list. Or, they might need to edit existing files to add data or to adhere to policies for standardization.

To write to a file, you will need to open the file with `"w"` or `"a"` as the second argument of `open()`.

You should use the `"w"` argument when you want to replace the contents of an existing file. When working with the existing file `update_log.txt`, the code `with open("update_log.txt", "w") as file:` opens it so that its contents can be replaced.

Additionally, you can use the `"w"` argument to create a new file. For example, `with open("update_log2.txt", "w") as file:` creates and opens a new file called `"update_log2.txt"`.

You should use the `"a"` argument if you want to append new information to the end of an existing file rather than writing over it. The code `with open("update_log.txt", "a") as file:` opens `"update_log.txt"` so that new information can be appended to the end. Its existing information will not be deleted.

Like when opening a file to read from it, you should indicate what to do with the file on the indented lines that follow when you open a file to write to it. With both `"w"` and `"a"`, you can use the `.write()` method. The `.write()` method writes string data to a specified file.

The following example uses the `.write()` method to append the content of the `line` variable to the file `"access_log.txt"`.

```
line = "jrafael,192.168.243.140,4:56:27,True"

with open("access_log.txt", "a") as file:

    file.write(line)
```

Note: Calling the `.write()` method without using the `with` keyword when importing the file might result in its arguments not being completely written to the file if the file is not properly closed in another way.

## Key takeaways

It's important for security analysts to be able to import files into Python and then read from or write to them. Importing Python files involves using the `with` keyword, the `open()` function, and the `as` keyword. Reading from and writing to files requires knowledge of the `.read()` and `.write()` methods and the arguments to the `open()` function of `"r"`, `"w"`, and `"a"`.

# Work with files in Python

You previously explored how to open files in Python as well as how to read them and write to them. You also examined how to adjust the structure of file contents through the `.split()` method. In this reading, you'll review the `.split()` method, and you'll also learn an additional method that can help you work with file contents.

## Parsing

Part of working with files involves structuring its contents to meet your needs. Parsing is the process of converting data into a more readable format. Data may need to become more readable in a couple of different ways. First, certain parts of your Python code may require modification into a specific format. By converting data into this format, you enable Python to process it in a specific way. Second, programmers need to read and interpret the results of their code, and parsing can also make the data more readable for them.

Methods that can help you parse your data include `.split()` and `.join()`.

### `.split()`

#### The basics of `.split()`

The `.split()` method converts a string into a list. It separates the string based on a specified character that's passed into `.split()` as an argument.

In the following example, the usernames in the `approved_users` string are separated by a comma. For this reason, a string containing the comma (" , ") is passed into `.split()` in order to parse it into a list. Run this code and analyze the different contents of `approved_users` before and after the `.split()` method is applied to it:

1

2

3

4

[Reset](#)

Before the `.split()` method is applied to `approved_users`, it contains a string, but after it is applied, this string is converted to a list.

If you do not pass an argument into `.split()`, it will separate the string every time it encounters a whitespace.

Note: A variety of characters are considered whitespaces by Python. These characters include spaces between characters, returns for new lines, and others.

The following example demonstrates how a string of usernames that are separated by space can be split into a list through the `.split()` method:

1

2

3

4

[Reset](#)

Because an argument isn't passed into `.split()`, Python splits the `removed_users` string at each space when separating it into a list.

## Applying `.split()` to files

The `.split()` method allows you to work with file content as a list after you've converted it to a string through the `.read()` method. This is useful in a variety of ways. For example, if you want to iterate through the file contents in a `for` loop, this can be easily done when it's converted into a list.

The following code opens the "update\_log.txt" file. It then reads all of the file contents into the `updates` variable as a string and splits the string in the `updates` variable into a list by creating a new element at each whitespace:

1

2

3

After this, through the `updates` variable, you can work with the contents of the "update\_log.txt" file in parts of your code that require it to be structured as a list.

Note: Because the line that contains `.split()` is not indented as part of the `with` statement, the file closes first. Closing a file as soon as it is no longer needed helps maintain code readability. Once a file is read into the `updates` variable, it is not needed and can be closed.

## **.join()**

### **The basics of .join()**

If you need to convert a list into a string, there is also a method for that. The `.join()` method concatenates the elements of an iterable into a string. The syntax used with `.join()` is distinct from the syntax used with `.split()` and other methods that you've worked with, such as `.index()`.

In methods like `.split()` or `.index()`, you append the method to the string or list that you're working with and then pass in other arguments. For example, the code `usernames.index(2)`, appends the `.index()` method to the variable `usernames`, which contains a list. It passes in 2 as the argument to indicate which element to return.

However, with `.join()`, you must pass the list that you want to concatenate into a string in as an argument. You append `.join()` to a character that you want to separate each element with once they are joined into a string.

For example, in the following code, the `approved_users` variable contains a list. If you want to join that list into a string and separate each element with a comma, you can use `" , ".join(approved_users)`. Run the code and examine what it returns:

1

2

3

4

[Reset](#)

Before `.join()` is applied, `approved_users` is a list of five elements. After it is applied, it is a string with each username separated by a comma.

Note: Another way to separate elements when using the `.join()` method is to use `"\n"`, which is the newline character. The `"\n"` character indicates to separate the elements by placing them on new lines.

## Applying `.join()` to files

When working with files, it may also be necessary to convert its contents back into a string. For example, you may want to use the `.write()` method. The `.write()` method writes string data to a file. This means that if you have converted a file's contents into a list while working with it, you'll need to convert it back into a string before using `.write()`. You can use the `.join()` method for this.

You already examined how `.split()` could be applied to the contents of the `"update_log.txt"` file once it is converted into a string through `.read()` and stored as `updates`:

1

2

3

After you're through performing operations using the list in the `updates` variable, you might want to replace `"update_log.txt"` with the new contents. To do so, you need to first convert `updates` back into a string using `.join()`. Then, you can open the file using a `with` statement and use the `.write()` method to write the `updates` string to the file:

1

2

3

The code `" ".join(updates)` indicates to separate each of the list elements in `updates` with a space once joined back into a string. And because `"w"` is specified as the second argument of `open()`, Python will overwrite the contents of `"update_log.txt"` with the string currently in the `updates` variable.

## Key takeaways

An important element of working with files is being able to parse the data it contains. Parsing means converting the data into a readable format. The `.split()` and `.join()` methods are both useful for parsing data. The `.split()` method allows you to convert a string into a list, and the `.join()` method allows you to convert a list into a string.

# Explore debugging techniques

Previously, you examined three types of errors you may encounter while working in Python and explored strategies for debugging these errors. This reading further explores these concepts with additional strategies and examples for debugging Python code.

## Types of errors

It's a normal part of developing code in Python to get error messages or find that the code you're running isn't working as you intended. The important thing is that you can figure out how to fix errors when they occur. Understanding the three main types of errors can help. These types include syntax errors, logic errors, and exceptions.

### Syntax errors

A syntax error is an error that involves invalid usage of a programming language. Syntax errors occur when there is a mistake with the Python syntax itself. Common examples of syntax errors include forgetting a punctuation mark, such as a closing bracket for a list or a colon after a function header.

When you run code with syntax errors, the output will identify the location of the error with the line number and a portion of the affected code. It also describes the error.

Syntax errors often begin with the label `"SyntaxError:"`. Then, this is followed by a description of the error. The description might simply be `"invalid syntax"`. Or if you forget a closing parentheses on a function, the description might be `"unexpected EOF while parsing"`. `"EOF"` stands for "end of file."

The following code contains a syntax error. Run it and examine its output:

1

2

[Reset](#)

This outputs the message `"SyntaxError: EOL while scanning string literal"`. `"EOL"` stands for "end of line". The error message also indicates that the error happens on the first line. The error occurred because a quotation mark was missing at the end of the string on the first line. You can fix it by adding that quotation mark.

Note: You will sometimes encounter the error label "`IndentationError`" instead of "`SyntaxError`". `IndentationError` is a subclass of `SyntaxError` that occurs when the indentation used with a line of code is not syntactically correct.

## Logic errors

A logic error is an error that results when the logic used in code produces unintended results. Logic errors may not produce error messages. In other words, the code will not do what you expect it to do, but it is still valid to the interpreter.

For example, using the wrong logical operator, such as a greater than or equal to sign (`>=`) instead of greater than sign (`>`) can result in a logic error. Python will not evaluate a condition as you intended. However, the code is valid, so it will run without an error message.

The following example outputs a message related to whether or not a user has reached a maximum number of five login attempts. The condition in the `if` statement should be `login_attempts < 5`, but it is written as `login_attempts >= 5`. A value of `5` has been assigned to `login_attempts` so that you can explore what it outputs in that instance:

2

3

4

5

[Reset](#)

The output displays the message "User has not reached maximum number of login attempts." However, this is not true since the maximum number of login attempts is five. This is a logic error.

Logic errors can also result when you assign the wrong value in a condition or when a mistake with indentation means that a line of code executes in a way that was not planned.

## Exceptions

An exception is an error that involves code that cannot be executed even though it is syntactically correct. This happens for a variety of reasons.

One common cause of an exception is when the code includes a variable that hasn't been assigned or a function that hasn't been defined. In this case, your output will include `"NameError"` to indicate that this is a name error. After you run the following code, use the error message to determine which variable was not assigned:

1

2

3

4

5

6

7

[Reset](#)

The output indicates there is a `"NameError"` involving the `unusual_logins` variable. You can fix this by assigning this variable a value.

In addition to name errors, the following messages are output for other types of exceptions:

- `"IndexError"`: An index error occurs when you place an index in bracket notation that does not exist in the sequence being referenced. For example, in the list `usernames = ["bmoreno", "tshah", "elarson"]`, the indices are `0`, `1`, and `2`. If you referenced this list with the statement `print(usernames[3])`, this would result in an index error.
- `"TypeError"`: A type error results from using the wrong data type. For example, if you tried to perform a mathematical calculation by adding a string value to an integer, you would get a type error.
- `"FileNotFoundException"`: A file not found error occurs when you try to open a file that does not exist in the specified location.

## Debugging strategies

Keep in mind that if you have multiple errors, the Python interpreter will output error messages one at a time, starting with the first error it encounters. After you fix that error and run the code again, the interpreter will output another message for the next syntax error or exception it encounters.

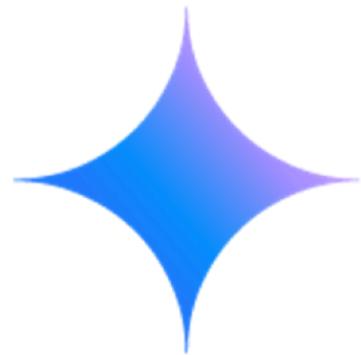
When dealing with syntax errors, the error messages you receive in the output will generally help you fix the error. However, with logic errors and exceptions, additional strategies may be needed.

## Debuggers

In this course, you have been running code in a notebook environment. However, you may write Python code in an Integrated Development Environment (IDE). An Integrated Development Environment (IDE) is a software application for writing code that provides editing assistance and error correction tools. Many IDEs offer error detection tools in the form of a debugger. A debugger is a software tool that helps to locate the source of an error and assess its causes.

In cases when you can't find the line of code that is causing the issue, debuggers help you narrow down the source of the error in your program. They do this by working with breakpoints. Breakpoints are markers placed on certain lines of executable code that indicate which sections of code should run when debugging.

Some debuggers also have a feature that allows you to check the values stored in variables as they change throughout your code. This is especially helpful for logic errors so that you can locate where variable values have unintentionally changed.



# Gemini

## Code Assist

Recent advancements in AI have opened up many opportunities for enhancing IDEs with powerful, context-aware coding assistance. These are tools that are integrated directly into the IDE or coding environment to provide a more seamless coding experience. For example, [Gemini Code Assist](#) is a free AI tool that integrates into popular IDEs like Visual Studio Code and JetBrains. It functions as an assistant that can help analyze code and find errors, suggest modifications, and also interact in a conversational way to answer many other questions, whether they're technical or more conceptual.

These tools are quickly becoming indispensable to coders and cybersecurity professionals as they facilitate and accelerate workflows, but if you choose to use them, please remember that this technology is still evolving. The suggestions, code, or explanations provided may not always be perfectly accurate, optimal, or secure. Always review and validate any AI-generated output before executing programs or relying on the information. Treat the AI assistance as a helpful co-pilot, but maintain oversight and responsibility for your final code.

## **Use print statements**

Another debugging strategy is to incorporate temporary print statements that are designed to identify the source of the error. You should strategically incorporate these print statements to print at various locations in the code. You can specify line numbers as well as descriptive text about the location.

For example, you may have code that is intended to add new users to an approved list and then display the approved list. The code should not add users that are already on

the approved list. If you analyze the output of this code after you run it, you will realize that there is a logic error:

1

2

3

4

5

6

7

8

9

[Reset](#)

Even though you get the message "**bmoreno already in list**", a second instance of "**bmoreno**" is added to the list. In the following code, print statements have been added to the code. When you run it, you can examine what prints:

1

2

3

4

5

6

7

8

9

10

11

12

[Reset](#)

The print statement "line 5 - inside for loop" outputs twice, indicating that Python has entered the `for` loop for each username in `new_users`. This is as expected. Additionally, the print statement "line 7 - inside if statement" only outputs once, and this is also as expected because only one of these usernames was already in `approved_users`.

However, the print statement "line 9 - before .append method" outputs twice. This means the code calls the `.append()` method for both usernames even though one is already in `approved_users`. This helps isolate the logic error to this area. This can help you realize that the line of code `approved_users.append(user)` should be the

body of an `else` statement so that it only executes when `user` is not in `approved_users`.

## Key takeaways

There are three main types of errors you'll encounter while coding in Python. Syntax errors involve invalid usage of the programming language. Logic errors occur when the logic produced in the code produces unintended results. Exceptions involve code that cannot be executed even though it is syntactically correct. You will receive error messages for syntax errors and exceptions that can help you fix these mistakes. Additionally, using debuggers and inserting print statements can help you identify logic errors and further debug exceptions.

# Reference guide: Python concepts from week 4

This reference guide contains Python language introduced during week 4. The guide is organized into the following sections:

- File operations
- Parsing

Within each section, items generally appear in the order they were introduced.

## **Access and save the guide**

You can save a copy of this guide for future reference. You can use it as a resource for additional practice or in your future professional projects.

To access a downloadable version of this course item, click the following link and select *Use Template*.

[Reference guide: Python concepts from module 4](#)

OR

If you don't have a Google account, you can download the item directly from the following attachment.

# **Glossary terms from module 4**

## **Terms and definitions from Course 7, Module 4**

Automation: The use of technology to reduce human and manual effort to perform common and repetitive tasks

Conditional statement: A statement that evaluates code to determine if it meets a specified set of conditions

Debugger: A software tool that helps to locate the source of an error and assess its causes

Debugging: The practice of identifying and fixing errors in code

Exception: An error that involves code that cannot be executed even though it is syntactically correct

File path: The location of a file or directory

Function: A section of code that can be reused in a program

Integrated development environment (IDE): A software application for writing code that provides editing assistance and error correction tools

Iterative statement: Code that repeatedly executes a set of instructions

Log: A record of events that occur within an organization's systems

Logic error: An error that results when the logic used in code produces unintended results

Parsing: The process of converting data into a more readable format

Syntax error: An error that involves invalid usage of a programming language

Variable: A container that stores data