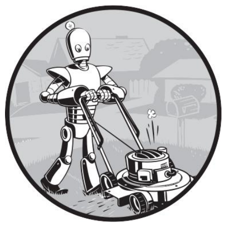
15

GOOGLE SHEETS



Google Sheets, the free, web-based spreadsheet application available to anyone with a Google account or Gmail address, has become a useful, feature-rich competitor to Excel. Google Sheets has its own API, but this API can be confusing to learn and use. This chapter covers the EZSheets third-party library, which presents you with a simpler way to perform common actions, handling the details of the Google Sheets API so that you don't have to learn them.

Installing and Setting Up EZSheets

You can install EZSheets with the pip command line tool by following the instructions in Appendix A.

Before your Python scripts can use EZSheets to access and edit your Google Sheets spreadsheets, you need a credentials JSON file and two token JSON files. There are five parts to creating credentials:

1. Create a new Google Cloud project.
2. Enable the Google Sheets API and Google Drive API for your project.
3. Configure the OAuth consent screen.
4. Create credentials.
5. Log in with the credentials file.

This may seem like a lot of work, but you have to perform this setup only once, and doing it is free. You'll need a Google/Gmail account; I strongly recommend creating a new Google account instead of using your existing one, to prevent a bug in your Python script from affecting the spreadsheets in your personal Google account. Throughout this chapter, I'll say *your Google account* and *your Gmail email address* to refer to the Google account that owns the spreadsheets your Python program accesses.

Google may slightly change the layout or wording on its Google Cloud Console website. However, the basic steps I've outlined should remain the same.

Creating a New Google Cloud Project

First, you need to set up a Google Cloud project. In your browser, go to *https://console.cloud.google.com* and sign in to your Google account with your username and password. You will be taken to a Getting Started page. At the top of the page, click **Select a project**. In the pop-up window that appears, click **New Project**. This should take you to a new project page.

Google Cloud will generate a project name like "My Project 23135" for you, along with a random project ID, like "macro-nuance-362516." These values won't be visible to users of your Python scripts, and you can change the project name to whatever name you want, but you cannot change the project ID. I just use the default name that the website generates for me. You can leave the location set to "No organization." Free Google accounts can have up to 12 projects, but you need only one project for all the Python scripts you want to create. Click the blue **Create** button to create the project.

Enabling the Sheets and Drive APIs

On the *https://console.cloud.google.com* page, click the **Navigation** button in the upper left. (The icon has three horizontal stripes and is often called the *hamburger* icon.) Go to **APIs & Services** ▸ **Library** to visit the API Library page. You'll see many Google APIs for Gmail, Google Maps, Google Cloud Storage, and other Google services. We need to allow our project to use the Google Sheets and Google Drive APIs. EZSheets uses the Google Drive API to upload and download spreadsheet files.

Scroll down, locate the Google Sheets API, and click it, or enter "Google Sheets API" into the search bar to find it. This should take you to the Google Sheets API page. Click the blue **Enable** button to enable your Google Cloud project to use the Google Sheets API. You'll be redirected to the **APIs & Services** ▸ **Enabled APIs & Services** page, where you can find information about how often your Python scripts are using this API. Repeat this process for the Google Drive API to enable it as well.

Next, you need to configure your project's OAuth consent screen.

Configuring the OAuth Consent Screen

The OAuth consent screen will appear to the user when they first run `import ezsheets`. On the *Step 1 OAuth consent screen* page, select **External** and click the blue **Create** button. The next page should show what the OAuth consent screen looks like. Pick a name for the App Name field (I use something generic, like "Python Google API Script"), and enter your email address for the User Support Email and Developer Contact Information field. Then click the **Save and Continue** button.

On the *Step 2 Scopes* page, define your project's scopes, or the permissions for the resources the project is allowed to access. Click the **Add or Remove Scopes** button, and in the new panel that appears, go through the table and check the checkboxes for the scopes *.../auth/drive* (the Google Drive API) and *.../auth/spreadsheets* (the Google Sheets API). Then, click the blue **Update** button and then click **Save and Continue**.

The *Step 3 Test users* page requires you to add the Gmail email addresses of the Google accounts that own the spreadsheets your Python script will interact with. Unless you go through Google's app approval process, your scripts are limited to interacting with the email addresses you provide in this step. Click the **+ Add Users** button. In the new panel that appears, enter the Gmail address of your Google account and click the blue **Add** button. Then click **Save and Continue**.

The *Step 4 Summary* page provides a summary of the previous steps. If all the information looks right, click the **BACK TO DASHBOARD** button. The next step is to create credentials for your project.

Creating Credentials

First, you'll need to create a credentials file. EZSheets needs this to use the Google API, even for spreadsheets that are publicly shared. From the Navigation sidebar menu, click **APIs & Services** and then **Credentials** to go to the Credentials page. Then click the **+ Create Credentials** link at the top of the page. A submenu should open asking what kind of credentials you want to create: API Key, OAuth Client ID, or Service Account. Click **OAuth Client ID**.

On the next page, select **Desktop App** for the Application Type and leave Name as the default "Desktop client 1." You can change it to a different name if you want; it doesn't appear to the users of your Python script. Click the blue **Create** button.

A pop-up window should appear. Click **Download JSON** to download the credentials file, which should have a name like *client_secret_282792235794-p2o9gfcub4htibfg2u207gcomco9nqm7.apps.googleusercontent.com.json*.

Place it in the same folder as your Python script. For simplicity, you can also rename the JSON file to *credentials-sheets.json*. EZSheets searches for *credentials-sheets.json* or any file that matches the *client_secret_*.json* format.

Logging In with the Credentials File

Run the Python interactive shell from the same folder that the credentials JSON file is in and then run **`import ezsheets`**. EZSheets automatically checks the current working directory for the credentials JSON file by calling the `ezsheets.init()` function. If the file is found, EZSheets launches your web browser to the OAuth consent screen to generate token files. EZSheets also requires these token files, named *token-drive.pickle* and *token-sheets .pickle*, along with the credentials file to access spreadsheets. Generating token files is a one-time setup step that won't happen the next time you run `import ezsheets`.

Sign in with your Google account. This must be the same email address you provided for the "Test User" when configuring the Google Cloud project's OAuth consent screen. You should get a warning message that reads, "Google hasn't verified this app," which is fine, because you are the app creator. Click the **Continue** link. You should arrive at another page that says something like "Python Google API Script wants access to your Google Account" (or whichever name you gave in the OAuth consent screen setup). Click **Continue**. You'll come to a plain web page that says, "The authentication flow has completed." You can now close the browser window.

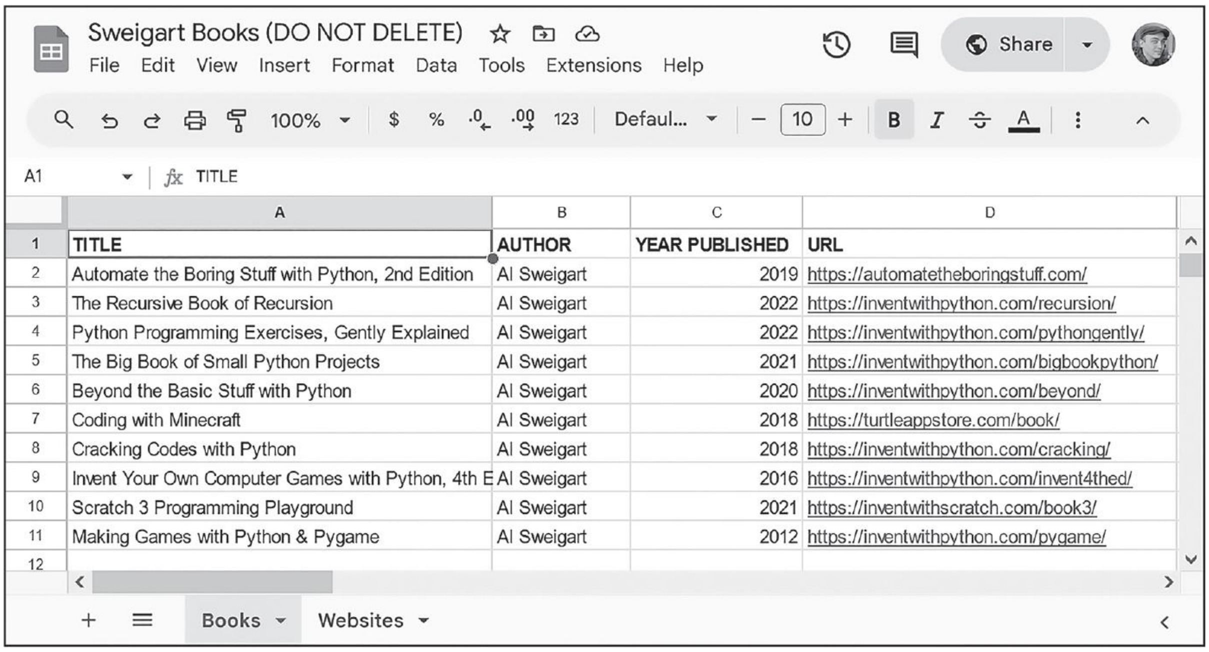
Once you've completed the authentication flow for the Sheets API, you must repeat this process for the Drive API in the window that opens next. After closing the second window, you should now see *token-drive.pickle* and *token-sheets.pickle* files in the same folder as your credentials JSON file. Treat these files like passwords and do not share them: they can be used to log in and access your Google Sheets spreadsheets.

Revoking the Credentials File

If you accidentally share the credential or token files with someone, they won't be able to change your Google account password, but they will have access to your spreadsheets. You can revoke these files by logging in to *https://console.developers.google.com*. Click the **Credentials** link on the sidebar. Then, in the OAuth 2.0 Client IDs table, click the trash can icon next to the credentials file you've accidentally shared. Once revoked, the credentials and token files are useless, and you can delete them. You'll then have to generate a new credentials JSON file and token files.

Spreadsheet Objects

In Google Sheets, a *spreadsheet* can contain multiple *sheets* (also called *worksheets*), and each sheet contains columns and rows of cells. Cells contain data such as numbers, dates, or bits of text. Cells also have properties such as fonts, widths and heights, and background colors. Figure 15-1 shows a spreadsheet titled *Sweigart Books* containing two sheets, titled *Books* and *Websites*. You can view this spreadsheet in your browser by going to *https://autbor.com/examplegs*. The first column of each sheet is labeled *A*, and the first row is labeled *1*. (This differs from Python lists, whose first item appears at index 0.)


Sweigart Books (DO NOT DELETE)
File Edit View Insert Format Data Tools Extensions Help
Share
100%
Defaul...
10
A1
TITLE
Books
Websites

	A	B	C	D
1	TITLE	AUTHOR	YEAR PUBLISHED	URL
2	Automate the Boring Stuff with Python, 2nd Edition	Al Sweigart	2019	https://automatetheboringstuff.com/
3	The Recursive Book of Recursion	Al Sweigart	2022	https://inventwithpython.com/recursion/
4	Python Programming Exercises, Gently Explained	Al Sweigart	2022	https://inventwithpython.com/pythongently/
5	The Big Book of Small Python Projects	Al Sweigart	2021	https://inventwithpython.com/bigbookpython/
6	Beyond the Basic Stuff with Python	Al Sweigart	2020	https://inventwithpython.com/beyond/
7	Coding with Minecraft	Al Sweigart	2018	https://turtleappstore.com/book/
8	Cracking Codes with Python	Al Sweigart	2018	https://inventwithpython.com/cracking/
9	Invent Your Own Computer Games with Python, 4th E	Al Sweigart	2016	https://inventwithpython.com/invent4thed/
10	Scratch 3 Programming Playground	Al Sweigart	2021	https://inventwithscratch.com/book3/
11	Making Games with Python & Pygame	Al Sweigart	2012	https://inventwithpython.com/pygame/
12				

Figure 15-1: A spreadsheet titled Sweigart Books *with two sheets,* Books *and* Websites

While most of your work will involve modifying the `Sheet` objects, you can also modify `Spreadsheet` objects, as you'll see in the next section.

Creating, Uploading, and Listing Spreadsheets

You can make a new `Spreadsheet` object from an existing Google Sheets spreadsheet, a new blank spreadsheet, or an uploaded Excel spreadsheet. All Google Sheets spreadsheets have a unique ID that can be found in their URL, after the *spreadsheets/d/* part and before the */edit* part. For example, in the URL *https://docs.google.com/spreadsheets/d/1TzOJxhNKr15tzdZxTqtQ3EmDP6em_elnbtmZIcyu8vI/edit#gid=0/*, the ID would be *1TzOJxhNKr15tzdZxTqtQ3EmDP6em_elnbtmZIcyu8vI*.

A Google Sheets spreadsheet is represented as an `ezsheets.Spreadsheet` object, which has `id`, `url`, and `title` attributes. You can create a new, blank spreadsheet with the `Spreadsheet()` function:

```
>>> import ezsheets
>>> ss = ezsheets.Spreadsheet()
>>> ss.title = 'Title of My New Spreadsheet'
>>> ss.title
'Title of My New Spreadsheet'
>>> ss.url
'https://docs.google.com/spreadsheets/d/1gxz-
Qr2-RNtqi_d7wWlsDlbtPLRQigcEXvCtdVwmH40/'
>>> ss.id
'1gxz-Qr2-
RNtqi_d7wWlsDlbtPLRQigcEXvCtdVwmH40'
```

You can also load an existing spreadsheet by passing its ID or URL, or a URL that redirects to its URL:

```
>>> import ezsheets
>>> ss1 = ezsheets.Spreadsheet('https://
autbor.com/examplegs')
>>> ss2 = ezsheets.Spreadsheet('https://
docs.google.com/spreadsheets/d/1TzOJxh
NKr15tzdZxTqtQ3EmDP6em_elnbtmZIcyu8vI/')
>>> ss3 =
ezsheets.Spreadsheet('1TzOJxhNKr15tzdZxTqtQ3E
mDP6em_elnbtmZIcyu8vI')
>>> ss1 == ss2 == ss3  # These are the same
spreadsheet.
True
```

To upload an existing Excel, OpenOffice, CSV, or TSV spreadsheet to Google Sheets, pass the spreadsheet's filename to `ezsheets.upload()`. Enter the following into the interactive shell, replacing *my_spreadsheet.xlsx* with a spreadsheet file of your own:

```
>>> import ezsheets
>>> ss =
ezsheets.upload('my_spreadsheet.xlsx')
>>> ss.title
'my_spreadsheet'
```

You can list the spreadsheets in your Google account by calling the `listSpreadsheets()` function. This function returns a dictionary whose keys are spreadsheet IDs and whose values are the titles of each spreadsheet. It includes deleted spreadsheets in your account's *Trash* folder. Try entering the following into the interactive shell after uploading a spreadsheet:

```
>>> ezsheets.listSpreadsheets()
{'1J-Jx6Ne2K_vqI9J2SO-
TAXOFbxx_9tUjwnkPC22LjeU': 'Education Data'}
```

Once you've obtained a `Spreadsheet` object, you can use its attributes and methods to manipulate the online spreadsheet hosted on Google Sheets.

Accessing Spreadsheet Attributes

While the actual data lives in a spreadsheet's individual sheets, the `Spreadsheet` object has the following attributes for manipulating the spreadsheet itself: `title`, `id`, `url`, `sheetTitles`, and `sheets`. Let's examine the spreadsheet at *https://autbor.com/examplegs*. Your Google account has permissions to view but not modify it, but you can copy the sheet to a newly created spreadsheet in your own account:

```
>>> import ezsheets
>>> example_ss =
ezsheets.Spreadsheet('https://autbor.com/
examplegs')
>>> ss = ezsheets.Spreadsheet()
>>> example_ss.sheets[0].copyTo(ss)
>>> ss.sheets[0].delete()  # Delete the
Sheet1 sheet.
```

```
>>> ss.url
'https://docs.google.com/spreadsheets/d/
15gjrbgTmUzItRt9KUcL4JajLaQU70xanstB1dXKoSlM/
'
```

The newly copied sheet will have the title *Copy of Books*, as *Books* was the name of the original sheet. Continue the interactive shell example with the following code:

```
>>> ss.title  # The title of the spreadsheet
'Untitled spreadsheet'
>>> ss.title = 'Sweigart
Books'  # Change the title.
>>> ss.id  # The unique ID (a read-only
attribute)
'15gjrbgTmUzItRt9KUcL4JajLaQU70xanstB1dXKoSlM
'
>>> ss.url  # The original URL (a read-only
attribute)
'https://docs.google.com/spreadsheets/d/
15gjrbgTmUzItRt9KUcL4JajLaQU70xanstB1dXKoSlM/
'
>>> ss.sheetTitles  # The titles of all the
Sheet objects
('Copy of Books',)
>>> ss.sheets  # The Sheet objects in this
Spreadsheet, in order
(<Sheet sheetId=1464919459, title='Copy of
Books', rowCount=1000, columnCount=26>,)
>>>
ss.sheets[0]  # The first Sheet object in
this Spreadsheet
<Sheet sheetId=1464919459, title='Copy of
Books', rowCount=1000, columnCount=26>
```

```
>>> ss['Copy of
Books']  # Sheets can also be accessed by
title.
<Sheet sheetId=1464919459, title='Copy of
Books', rowCount=1000, columnCount=26>
>>> ss.Sheet('New blank sheet')  # Create a
new sheet.
<Sheet sheetId=1759616008, title='New blank
sheet', rowCount=1000, columnCount=26>
>>> ss.sheets[1].delete()  # Delete the
second Sheet object in this Spreadsheet.
```

If someone changes the spreadsheet in their browser, your script can update the `Spreadsheet` object to match the online data by calling the `refresh()` method:

```
>>> ss.refresh()
```

This will refresh not only the `Spreadsheet` object's attributes but also the data in the `Sheet` objects it contains. You'll see the changes you make to the `Spreadsheet` object applied to the online spreadsheet in real time.

Downloading and Uploading Spreadsheets

You can download a Google Sheets spreadsheet in a number of formats: Excel, OpenOffice, CSV, TSV, and PDF. You can also download it as a ZIP file containing HTML files of the spreadsheet's data. EZSheets contains functions for each of these options:

```
>>> import ezsheets
>>> ss = ezsheets.Spreadsheet('https://
autbor.com/examplegs')
>>> ss.title
'Sweigart Books (DO NOT DELETE)'
>>> ss.downloadAsExcel()  # Downloads the
```

```
spreadsheet as an Excel file
'Sweigart_Books.xlsx'
>>> ss.downloadAsODS()  # Downloads the
spreadsheet as an OpenOffice file
'Sweigart_Books.ods'
>>> ss.downloadAsCSV()  # Downloads only the
first sheet as a CSV file
'Sweigart_Books.csv'
>>> ss.downloadAsTSV()  # Downloads only the
first sheet as a TSV file
'Sweigart_Books.tsv'
>>> ss.downloadAsPDF()  # Downloads the
spreadsheet as a PDF
'Sweigart_Books.pdf'
>>> ss.downloadAsHTML()  # Downloads the
spreadsheet as a ZIP of HTML files
'Sweigart_Books.zip'
```

Note that files in the CSV or TSV format can contain only one sheet; therefore, if you download a Google Sheets spreadsheet in either of these formats, you will get the first sheet only. To download other sheets, you'll need to reorder the `Sheet` objects before downloading.

The download functions all return a string of the downloaded file's filename. You can also specify your own filename for the spreadsheet by passing the new filename to the download function:

```
>>> ss.downloadAsExcel('a_different_filename.
xlsx')
'a_different_filename.xlsx'
```

The function returns the local filename.

Deleting Spreadsheets

To delete a spreadsheet, call the `delete()` method:

```
>>> import ezsheets
>>> ss =
ezsheets.Spreadsheet()  # Create the
spreadsheet.
>>> ezsheets.listSpreadsheets()  # Confirm
that we've created a spreadsheet.
{'1aCw2NNJSZblDbhygVv77kPsL3djmgV5zJZllSOZ_mR
k': 'Delete me'}
>>> ss.delete()  # Delete the spreadsheet.
>>> ezsheets.listSpreadsheets()  #
Spreadsheets in the Trash folder are still
listed.
{'1aCw2NNJSZblDbhygVv77kPsL3djmgV5zJZllSOZ_mR
k': 'Delete me'}
```

The `delete()` method will move your spreadsheet to the *Trash* folder on your Google Drive. You can view the contents of your *Trash* folder at *https://drive.google.com/drive/trash*. Notice that spreadsheets in the *Trash* folder will still appear in the dictionary returned by `listSpreadsheets()`. To permanently delete your spreadsheet, pass `True` for the `permanent` keyword argument:

```
>>> ss.delete(permanent=True)
>>> ezsheets.listSpreadsheets()
{}
```

In general, permanently deleting your spreadsheets with automated scripts is not a good idea, because it's impossible to recover a spreadsheet that a bug in your script accidentally deleted. Even free Google Drive accounts have gigabytes of storage available, so you most likely don't need to worry about freeing up space.

Sheet Objects

A `Spreadsheet` object will have one or more `Sheet` objects. The `Sheet` objects represent the rows and columns of data in each sheet.

You can access these sheets using the square brackets operator and an integer index.

The `Spreadsheet` object's `sheets` attribute holds a tuple of `Sheet` objects in the order in which they appear in the spreadsheet. To access the `Sheet` objects in a spreadsheet, enter the following into the interactive shell:

```
>>> import ezsheets
>>> ss = ezsheets.Spreadsheet()  # Starts
with a sheet named Sheet1
>>> sheet2 = ss.Sheet('Spam')
>>> sheet3 = ss.Sheet('Eggs')
>>> ss.sheets  # The Sheet objects in this
Spreadsheet, in order
(<Sheet sheetId=0, title='Sheet1',
rowCount=1000, columnCount=26>, <Sheet
sheetId=284204004,
title='Spam', rowCount=1000, columnCount=26>,
<Sheet sheetId=1920032872, title='Eggs',
rowCount=1000, columnCount=26>)
>>> ss.sheets[0]  # Gets the first Sheet
object in this Spreadsheet
<Sheet sheetId=0, title='Sheet1',
rowCount=1000, columnCount=26>
```

The `Spreadsheet` object's `sheetTitles` attribute holds a tuple of all the sheet titles. For example, enter the following into the interactive shell:

```
>>> ss.sheetTitles  # The titles of all the
Sheet objects in this Spreadsheet
('Sheet1', 'Spam', 'Eggs')
```

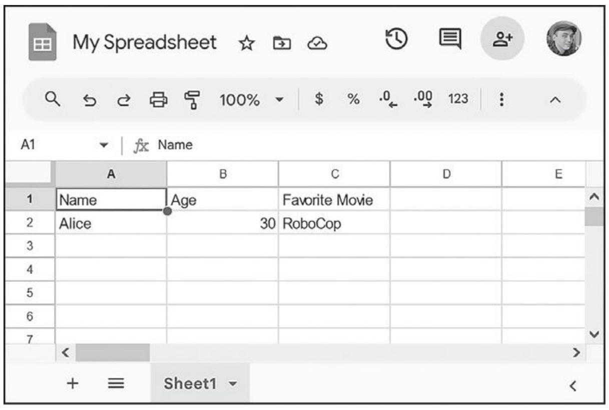
Once you have a `Sheet` object, you can read data from it and write data to it using the `Sheet` object's methods, as explained in the next section.

Reading and Writing Data

Just as in Excel, Google Sheets worksheets have columns and rows of cells containing data. You can use the square brackets operator `[]` to read and write data from and to these cells. For example, to create a new spreadsheet and add data to it, enter the following into the interactive shell:

```
>>> import ezsheets
>>> ss = ezsheets.Spreadsheet()
>>> ss.title = 'My Spreadsheet'
>>> sheet = ss.sheets[0]  # Get the first
sheet in this spreadsheet.
>>> sheet.title
'Sheet1'
>>> sheet['A1'] = 'Name'  # Set the value in
cell A1.
>>> sheet['B1'] = 'Age'
>>> sheet['C1'] = 'Favorite Movie'
>>> sheet['A1']  # Read the value in cell A1.
'Name'
>>>
sheet['A2']  # Empty cells return a blank
string.
''
>>> sheet[2, 1]  # Column 2, Row 1 is the
same address as B1.
'Age'
>>> sheet['A2'] = 'Alice'
>>> sheet['B2'] = 30
>>> sheet['C2'] = 'RoboCop'
>>> sheet['B2']  # Note that all data is
returned as strings.
'30'
```

These instructions should produce a Google Sheets spreadsheet that looks like Figure 15-2.



	A	B	C	D	E
1	Name	Age	Favorite Movie		
2	Alice	30	RoboCop		
3					
4					
5					
6					
7					

Figure 15-2 The spreadsheet created with the example instructions

All of the data in the `Sheet` object is loaded when the `Spreadsheet` object is first loaded, so the data is read instantly. However, writing values to the online spreadsheet requires a network connection and can take about a second. If you have thousands of cells to update, updating them one at a time might be quite slow. Instead, the next couple of sections will show you how to update entire rows and columns at once.

Addressing Columns and Rows

Cell addressing works in Google Sheets just like in Excel. The only difference is that, unlike Python's 0-based list indexes, Google Sheets have 1-based columns and rows: the first column or row is at index 1, not 0. You can convert from the `'A2'` string-style address to the `(column, row)` tuple-style address (and vice versa) with the `convertAddress()` function. The `getColumnLetterOf()` and `getColumnNumberOf()` functions will also convert a column address between letters and numbers. For example, enter the following into the interactive shell:

```
>>> import ezsheets
>>>
ezsheets.convertAddress('A2')  # Converts
addresses...
(1, 2)
>>> ezsheets.convertAddress(1, 2)  # ...and
converts them back, too.
'A2'
```

```
>>> ezsheets.getColumnLetterOf(2)
'B'
>>> ezsheets.getColumnNumberOf('B')
2
>>> ezsheets.getColumnLetterOf(999)
'ALK'
>>> ezsheets.getColumnNumberOf('ZZZ')
18278
```

The `'A2'` string-style addresses are convenient if you're typing addresses into your source code. But the `(column, row)` tuple-style addresses are convenient if you're looping over a range of addresses and need a numeric identifier for the column. The `convertAddress()`, `getColumnLetterOf()`, and `getColumnNumberOf()` functions are helpful when you need to convert between the two formats.

Reading and Writing Entire Columns and Rows

As mentioned, writing data one cell at a time can often take too long. Fortunately, EZSheets has `Sheet` methods for reading and writing entire columns and rows at the same time. The `getColumn()`, `getRow()`, `updateColumn()`, and `updateRow()` methods will, respectively, read and write columns and rows. These methods make requests to the Google Sheets servers to update the spreadsheet, so they require that you be connected to the internet. In this section's example, we'll upload *produceSales3.xlsx* from Chapter 14 to Google Sheets. You can download it from this book's online resources. The first eight rows look like Table 15-1.

Table 15-1: The First Eight Rows of the *produceSales3.xlsx* Spreadsheet

	A	B	C	D
1	PRODUCE	COST PER POUND	POUNDS SOLD	TOTAL
2	Potatoes	0.86	21.6	18.58
3	Okra	2.26	38.6	87.24
4	Fava beans	2.69	32.8	88.23
5	Watermelon	0.66	27.3	18.02
6	Garlic	1.19	4.9	5.83
7	Parsnips	2.27	1.1	2.5
8	Asparagus	2.49	37.9	94.37

To upload this spreadsheet, put the *produceSales3.xlsx* file in the current working directory and enter the following into the interactive shell:

```
>>> import ezsheets
>>> ss =
ezsheets.upload('produceSales3.xlsx')
>>> sheet = ss.sheets[0]
>>> sheet.getRow(1)  # The first row is row
1, not row 0.
['PRODUCE', 'COST PER POUND', 'POUNDS SOLD',
'TOTAL', '', '']
>>> sheet.getRow(2)
['Potatoes', '0.86', '21.6', '18.58', '', '']
>>> sheet.getColumn(1)
['PRODUCE', 'Potatoes', 'Okra', 'Fava beans',
'Watermelon', 'Garlic',
--snip--
>>> sheet.getColumn('A')  # The same result
as getColumn(1)
['PRODUCE', 'Potatoes', 'Okra', 'Fava beans',
'Watermelon', 'Garlic',
--snip--
>>> sheet.getRow(3)
['Okra', '2.26', '38.6', '87.24', '', '']
>>> sheet.updateRow(3, ['Pumpkin', '11.50',
'20', '230'])
>>> sheet.getRow(3)
['Pumpkin', '11.50', '20', '230', '', '']
>>> columnOne = sheet.getColumn(1)
>>> for i, value in enumerate(columnOne):
...     # Make the Python list contain
uppercase strings:
...     columnOne[i] = value.upper()
...
```

```
>>> sheet.updateColumn(1, columnOne)  #
Update the entire column in one request.
```

The `getRow()` and `getColumn()` functions retrieve the data from every cell in a specific row or column as a list of values. Note that empty cells become blank string values in the list. You can pass `getColumn()` either a column number or a letter to tell it to retrieve a specific column's data. The previous example shows that `getColumn(1)` and `getColumn('A')` return the same list.

The `updateRow()` and `updateColumn()` functions will overwrite the data in the row or column, respectively, with the list of values passed to the function. In this example, the third row initially contains information about okra, but the `updateRow()` call replaces it with data about pumpkins. Call `sheet.getRow(3)` again to view the new values in the third row.

Updating cells one at a time is slow if you have many cells to update. Getting a column or row as a list, updating the list, and then updating the entire column or row with the list is much faster, because you can make all changes in one request to Google's cloud services.

To get all of the rows at once, call the `getRows()` method to return a list of lists. The inner lists inside the outer list each represent a single row of the sheet. You can modify the values in this data structure to change the produce name, pounds sold, and total cost of some of the rows. Then, you can pass it to the `updateRows()` method by entering the following into the interactive shell:

```
>>> rows = sheet.getRows()  # Get every row
in the spreadsheet.
>>> rows[0]  # Examine the values in the
first row.
['PRODUCE', 'COST PER POUND', 'POUNDS SOLD',
'TOTAL', '', '']
>>> rows[1]
['POTATOES', '0.86', '21.6', '18.58', '', '']
>>> rows[1][0] = 'PUMPKIN'  # Change the
produce name.
>>> rows[1]
['PUMPKIN', '0.86', '21.6', '18.58', '', '']
```

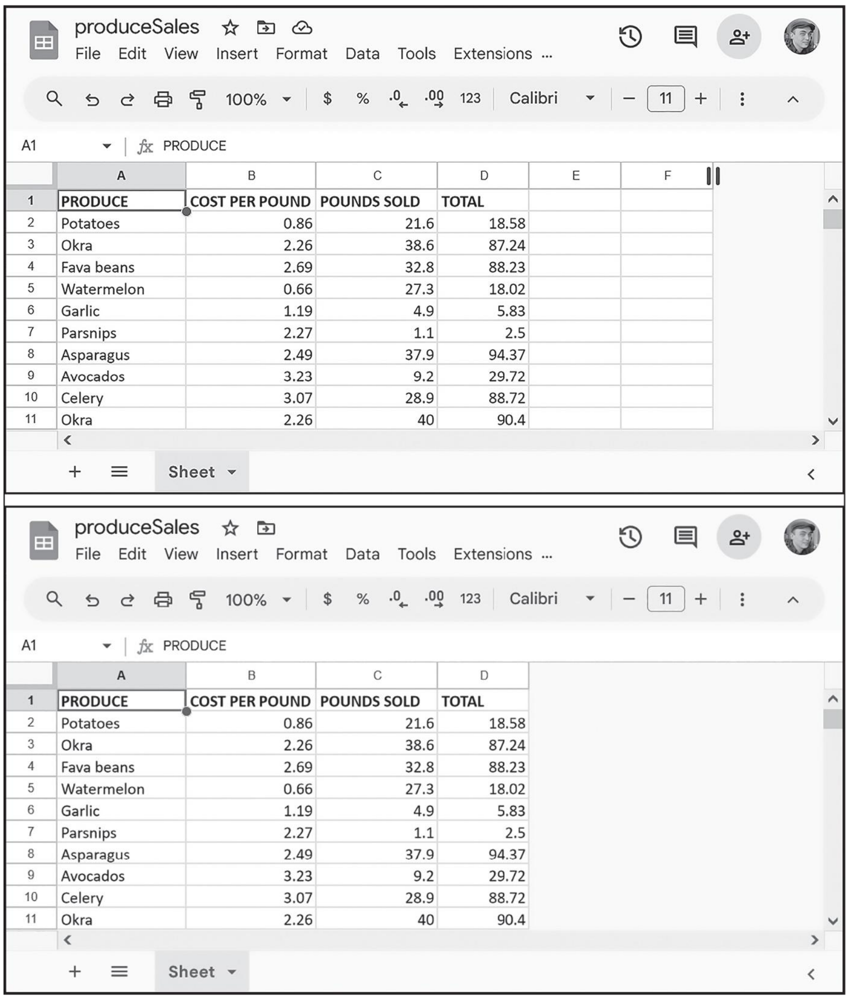
```
>>> rows[10]
['OKRA', '2.26', '40', '90.4', '', '']
>>> rows[10][2] = '400'  # Change the pounds
sold.
>>> rows[10][3] = '904'  # Change the total.
>>> rows[10]
['OKRA', '2.26', '400', '904', '', '']
>>> sheet.updateRows(rows)  # Update the
online spreadsheet with the changes.
```

You can update the entire sheet in a single request by passing `updateRows()` the list of lists returned from `getRows()`, amended with the changes made to rows 1 and 10.

Note that the rows in the Google Sheets spreadsheet have empty strings at the end. This is because the uploaded sheet has a column count of `6`, but we have only four columns of data. You can read the number of rows and columns in a sheet with the `rowCount` and `columnCount` attributes. Then, by setting these values, you can change the size of the sheet:

```
>>> sheet.rowCount  # The number of rows in
the sheet
23758
>>> sheet.columnCount  # The number of
columns in the sheet
6
>>> sheet.columnCount = 4  # Change the
number of columns to 4.
>>> sheet.columnCount  # Now the number of
columns in the sheet is 4.
4
```

These instructions should delete the fifth and sixth columns of the *produceSales3.xlsx* spreadsheet, as shown in Figure 15-3.



	A	B	C	D	E	F
1	PRODUCE	COST PER POUND	POUNDS SOLD	TOTAL		
2	Potatoes	0.86	21.6	18.58		
3	Okra	2.26	38.6	87.24		
4	Fava beans	2.69	32.8	88.23		
5	Watermelon	0.66	27.3	18.02		
6	Garlic	1.19	4.9	5.83		
7	Parsnips	2.27	1.1	2.5		
8	Asparagus	2.49	37.9	94.37		
9	Avocados	3.23	9.2	29.72		
10	Celery	3.07	28.9	88.72		
11	Okra	2.26	40	90.4		

	A	B	C	D
1	PRODUCE	COST PER POUND	POUNDS SOLD	TOTAL
2	Potatoes	0.86	21.6	18.58
3	Okra	2.26	38.6	87.24
4	Fava beans	2.69	32.8	88.23
5	Watermelon	0.66	27.3	18.02
6	Garlic	1.19	4.9	5.83
7	Parsnips	2.27	1.1	2.5
8	Asparagus	2.49	37.9	94.37
9	Avocados	3.23	9.2	29.72
10	Celery	3.07	28.9	88.72
11	Okra	2.26	40	90.4

Figure 15-3: The sheet before (top) and after (bottom) changing the column count to four

According to Google's documentation, Google Sheets spreadsheets can have up to 10 million cells in them. However, it's a good idea to make sheets only as big as you need to minimize the time it takes to update and refresh the data.

Creating, Moving, and Deleting Sheets

All Google Sheets spreadsheets start with a single sheet named *Sheet1*. You can add additional sheets to the end of the list of sheets with the `Sheet()` method, which accepts an optional string to use as the new sheet's title. An optional second argument can specify the integer index of the new sheet. To create a spreadsheet and then add new sheets to it, enter the following into the interactive shell:

```
>>> import ezsheets
>>> ss = ezsheets.Spreadsheet()
>>> ss.title = 'Multiple Sheets'
>>> ss.sheetTitles
('Sheet1',)
>>>
```

```
ss.Sheet('Spam')  # Create a new sheet at the
end of the list of sheets.
<Sheet sheetId=2032744541, title='Spam',
rowCount=1000, columnCount=26>
>>> ss.Sheet('Eggs')  # Create another new
sheet.
<Sheet sheetId=417452987, title='Eggs',
rowCount=1000, columnCount=26>
>>> ss.sheetTitles
('Sheet1', 'Spam', 'Eggs')
>>> ss.Sheet('Bacon',
0)  # Create a sheet at index 0 in the list
of sheets.
<Sheet sheetId=814694991, title='Bacon',
rowCount=1000, columnCount=26>
>>> ss.sheetTitles
('Bacon', 'Sheet1', 'Spam', 'Eggs')
```

These instructions add three new sheets to the spreadsheet: *Bacon*, *Spam*, and *Eggs* (in addition to the default *Sheet1*). The sheets in a spreadsheet are ordered, and new sheets go to the end of the list unless you pass a second argument to `Sheet()` specifying the sheet's index. Here, you create the sheet titled *Bacon* at index `0`, making *Bacon* the first sheet in the spreadsheet and displacing the other three sheets by one position. This is similar to the behavior of the `insert()` list method.

You can see the new sheets on the tabs at the bottom of the screen, as shown in Figure 15-4.

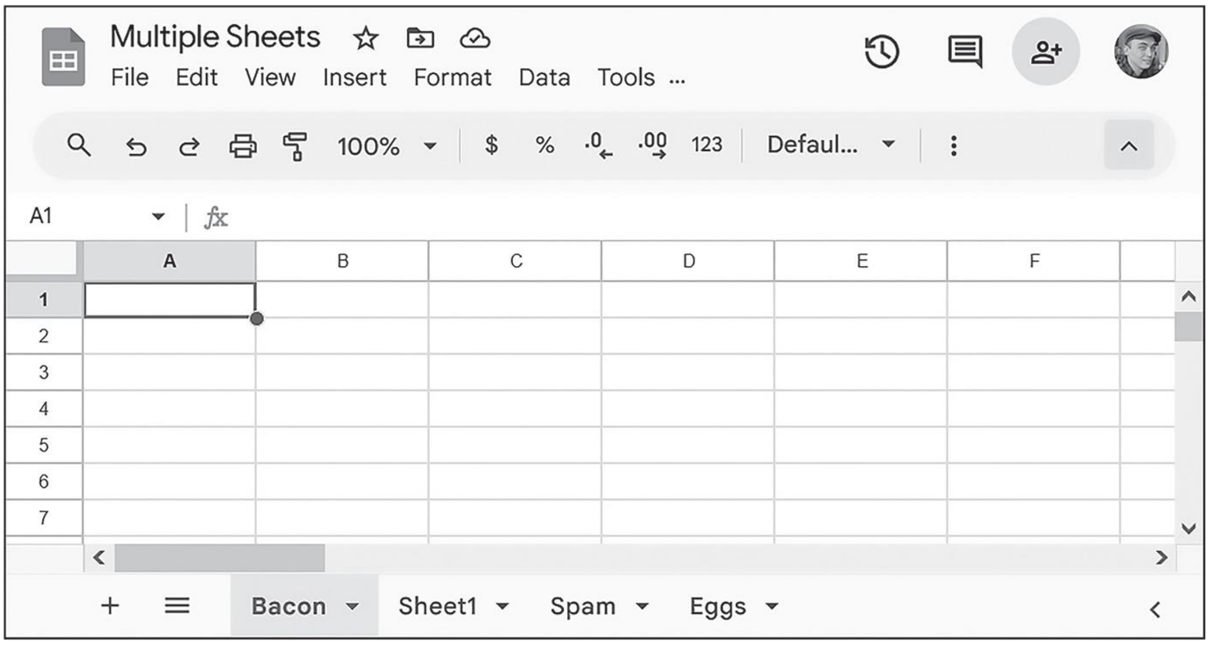


Figure 15-4: The Multiple Sheets *spreadsheet after adding sheets* Spam*,* Eggs*, and* Bacon

You can get the order of a sheet from its index attribute and then assign a new index to this attribute to reorder the sheet:

```
>>> ss.sheetTitles
('Bacon', 'Sheet1', 'Spam', 'Eggs')
>>> ss.sheets[0].index
0
>>> ss.sheets[0].index = 2  # Move the sheet
at index 0 to index 2.
>>> ss.sheetTitles
('Sheet1', 'Spam', 'Bacon', 'Eggs')
>>> ss.sheets[2].index = 0  # Move the sheet
at index 2 to index 0.
>>> ss.sheetTitles
('Bacon', 'Sheet1', 'Spam', 'Eggs')
```

The `Sheet` object's `delete()` method will delete the sheet from the spreadsheet. If you want to keep the sheet but delete the data it contains, call the `clear()` method to clear all the cells and make it a blank sheet. Enter the following into the interactive shell:

```
>>> ss.sheetTitles
('Bacon', 'Sheet1', 'Spam', 'Eggs')
>>> ss.sheets[0].delete()  # Delete the sheet at index 0: the "Bacon" sheet.
>>> ss.sheetTitles
('Sheet1', 'Spam', 'Eggs')
>>> ss['Spam'].delete()  # Delete the "Spam" sheet.
>>> ss.sheetTitles
('Sheet1', 'Eggs')
>>> sheet = ss['Eggs']  # Assign a variable to the "Eggs" sheet.
>>> sheet.delete()  # Delete the "Eggs" sheet.
>>> ss.sheetTitles
('Sheet1',)
>>> ss.sheets[0].clear()  # Clear all the cells on the "Sheet1" sheet.
>>> ss.sheetTitles  # The "Sheet1" sheet is empty but still exists.
('Sheet1',)
```

Deleting sheets is permanent; there's no way to recover the data. However, you can back up sheets by copying them to another spreadsheet with the `copyTo()` method, as explained in the next section.

Copying Sheets

Every `Spreadsheet` object has an ordered list of the `Sheet` objects it contains, and you can use this list to reorder the sheets (as shown in the previous section) or copy them to other spreadsheets. To copy a `Sheet` object to another `Spreadsheet` object, call the `copyTo()` method. Pass it the destination `Spreadsheet` object as an argument. To create two spreadsheets and copy the first spreadsheet's data to the other sheet, enter the following into the interactive shell:

```
>>> import ezsheets
>>> ss1 = ezsheets.Spreadsheet()
>>> ss1.title = 'First Spreadsheet'
>>> ss1.sheets[0].title = 'Spam'  # ss1 will
have a sheet named Spam.
>>> ss2 = ezsheets.Spreadsheet()
>>> ss2.title = 'Second Spreadsheet'
>>> ss2.sheets[0].title = 'Eggs'  # ss2 will
have a sheet named Eggs.
>>> ss1[0]
<Sheet sheetId=0, title='Spam',
rowCount=1000, columnCount=26>
>>> ss1[0].updateRow(1, ['Some', 'data',
'in', 'the', 'first', 'row'])
>>> ss1[0].copyTo(ss2)  # Copy the ss1's
Sheet1 to the ss2 spreadsheet.
>>> ss2.sheetTitles  # ss2 now contains a
copy of ss1's Sheet1.
('Eggs', 'Copy of Spam')
```

Copied sheets appear with a prefix of `Copy of` at the end of the list of the destination spreadsheet's sheets. If you wish, you can change their `index` attribute to reorder them in the new spreadsheet.

Google Forms

Your Google account also gives you access to Google Forms at *https://forms.google.com/*. You can create surveys, event registrations, or feedback forms with Google Forms, then receive the answers that users submit in a Google Sheets spreadsheet. Using EZSheets, your Python programs can access this data from the spreadsheet.

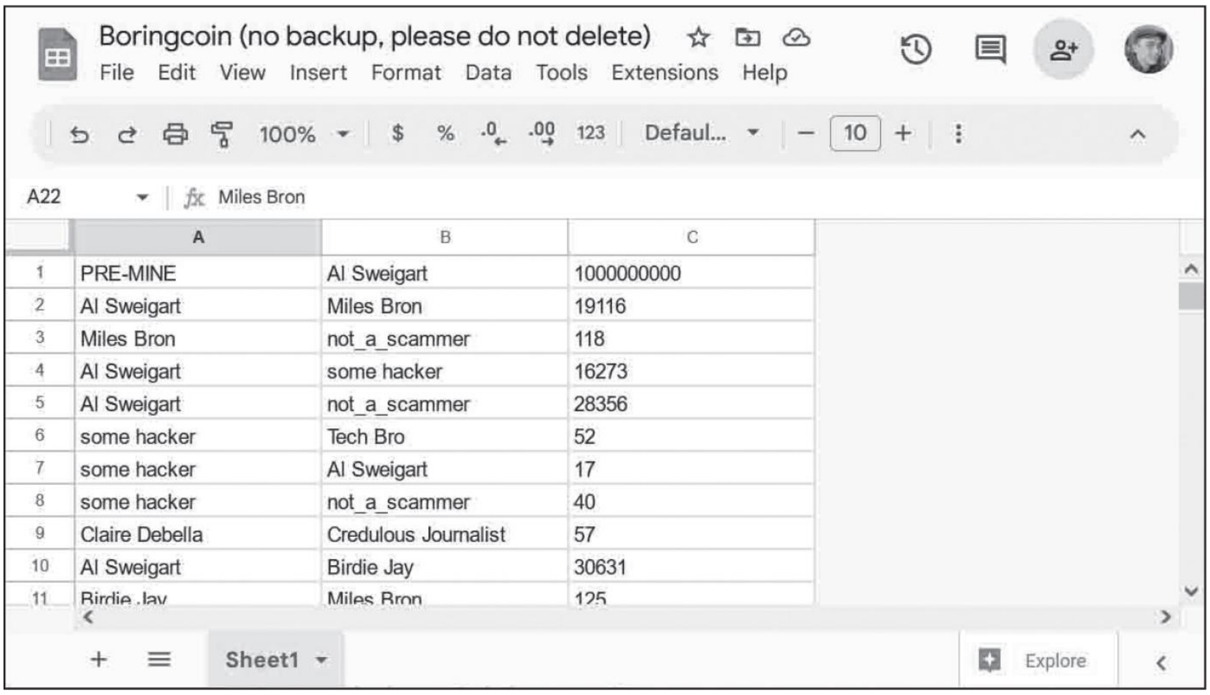
In Chapter 19, you'll learn to schedule your Python programs to run at regular, specified times. You could write a program that regularly checks a Google Forms spreadsheet for responses and detect any new entries it hasn't seen before. Then, using the information in Chapter 20, you can have the program send you a text so that you can get real-time notifications when a form is filled out.

As you've seen, Python is well-known as a "glue" language for tying together multiple existing software systems, letting you create an automated process more powerful than the sum of its parts.

Project 11: Fake Blockchain Cryptocurrency Scam

In this project, we'll use Google Sheets as a fake blockchain to track the transactions of Boringcoin, a cryptocurrency scam I'm promoting. (It turns out that investors and customers don't care if your blockchain product uses a real blockchain data structure; they will give you money anyway.)

The URL *https://autbor.com/boringcoin* redirects to the Google Sheets URL for Boringcoin's blockchain. The spreadsheet has three columns: the sender of the transaction, the recipient of the transaction, and the amount of the transaction. The amount is deducted from the sender and added to the recipient. If the sender is `'PRE-MINE'`, this money is created out of thin air and added to the recipient account. Figure 15-5 shows this Google Sheet.


Boringcoin (no backup, please do not delete)
File Edit View Insert Format Data Tools Extensions Help
100%
Defaul...
10
A22
Miles Bron
Sheet1
Explore

	A	B	C
1	PRE-MINE	Al Sweigart	1000000000
2	Al Sweigart	Miles Bron	19116
3	Miles Bron	not_a_scammer	118
4	Al Sweigart	some hacker	16273
5	Al Sweigart	not_a_scammer	28356
6	some hacker	Tech Bro	52
7	some hacker	Al Sweigart	17
8	some hacker	not_a_scammer	40
9	Claire Debella	Credulous Journalist	57
10	Al Sweigart	Birdie Jay	30631
11	Birdie Jay	Miles Bron	125

Figure 15-5: The fake blockchain for Boringcoin, stored on a Google Sheet

The first transaction has the sender `'PRE-MINE'` and the recipient `'Al Sweigart'`, and the amount is a humble `1000000000`. The `'Al Sweigart'` account then transfers `19116` Boringcoins to `'Miles Bron'`, who then transfers `118` Boringcoins to `'not_a_scammer'`. The fourth transaction transfers `16273` Boringcoins from `'Al Sweigart'` to `'some hacker'`. (I did not authorize this transaction and have since stopped using *python12345* as my Google account password.)

Let's write two programs. First, the *auditBoringcoin.py* program examines all the transactions and generates a dictionary of all accounts and their current balance. Second, the *addBoringcoinTransaction.py* program adds a row to the end of the Google Sheets for a new transaction. These blockchain programs are just for fun and not real (though "real" blockchain projects such as NFTs and "web3" are just as much a fantasy).

Step 1: Audit the Fake Blockchain

We need to write a program to examine the entire "blockchain" and determine the current balance of all accounts. We'll use a dictionary to hold this data, where the keys are strings of the account name and the values are integers of how many Boringcoins are in them. We also want the program to display how many total Boringcoins are in the cryptocurrency network. We can start by importing EZSheets and setting up the dictionary:

```
import ezsheets
ss = ezsheets.Spreadsheet('https://
autbor.com/boringcoin')
accounts = {}  # Keys are names, and values
are amounts.
```

Next, we'll loop through every row in the spreadsheet, identifying the sender, recipient, and amount. Keep in mind that Google Sheets always returns data as a string, so we need to convert it to an integer to do math with the `amount` value:

```
# Each row is a transaction. Loop over each
one:
for row in ss.sheets[0].getRows():
    sender, recipient, amount = row[0],
row[1], int(row[2])
```

If the sender is the special account `'PRE-MINE'`, then it is simply a source of infinite money into other accounts. All of the best cryptocurrency scams use pre-mined coins, and ours is no exception.

Add the amount to the recipient account in the `accounts` dictionary. The `setdefault()` method sets the value of the account to `0` if it doesn't already exist in the dictionary:

```
    if sender == 'PRE-MINE':
        # The 'PRE-MINE' sender invents money
out of thin air.
        accounts.setdefault(recipient, 0)
        accounts[recipient] += amount
```

Otherwise, we should deduct the amount from the sender and add it to the recipient:

```
    else:
        # Move funds from the sender to the
recipient.
        accounts.setdefault(sender, 0)
        accounts.setdefault(recipient, 0)
        accounts[sender] -= amount
        accounts[recipient] += amount
```

After the loop finishes, we can see the current balances by printing the accounts dictionary.

```
print(accounts)
```

As part of our audit, let's also go through this dictionary and add up the totals of everyone's balance to find out how many Boringcoins are in the entire network. Start a `total` variable at `0`, and then have a `for` loop go through each value in the key-value pairs of the `accounts` dictionary. After adding each value to `total`, we can print the total amount of Boringcoins:

```
total = 0
for amount in accounts.values():
    total += amount
print('Total Boringcoins:', total)
```

When we run this program, the output looks like this:

```
{'Al Sweigart': 999058553, 'Miles Bron':
38283, 'not_a_scammer': 48441,
'some hacker': 44429, 'Tech Bro': 53424,
'Claire Debella': 54443,
'Credulous Journalist': 50408, 'Birdie Jay':
36832, 'Carol': 82867, 'Mark Z.':
 68650, 'Bob': 37920, 'Andi Brand': 57218,
'Eve': 88296, 'Al Sweigart sock
#27': 78080, 'Tax evader': 40937, 'Duke
Cody': 17544, 'Lionel Toussaint':
54650, 'some scammer': 2694, 'Alice': 44503,
'David': 41828}
Total Boringcoins: 1000000000
```

The total is `1000000000`, which makes sense, because that's how many Boringcoins were pre-mined.

Step 2: Make Transactions

The next program, *addBoringcoinTransaction.py*, adds additional rows to the "blockchain" Google Sheet to add new transactions. It reads three command line arguments from the list in `sys.argv`: the sender, the recipient, and the amount. For example, you could run the following from the terminal:

```
python addBoringcoinTransaction.py "Al
Sweigart" Eve 2000
```

The program would access the Google Sheet, add a blank row to the bottom, and then fill it in with the values `'Al Sweigart'`, `'Eve'`, and `'2000'`. Note that in the terminal, you'll need to enclose any command line argument that contains a space in double quotes, like

"Al Sweigart"; otherwise, the terminal will think they are two separate arguments.

The start of *addBoringcoinTransactions.py* checks the command line arguments and assigns the sender, recipient, and amount variables based on them:

```
import sys, ezsheets

if len(sys.argv) < 4:
    print('Usage: python
addBoringcoinTransaction.py sender recipient
amount')
    sys.exit()

# Get the transaction info from the command
line arguments:
sender, recipient, amount = sys.argv[1:]
```

You won't need to convert `amount` from a string to an integer, because we'll be writing it as a string to the spreadsheet.

Next, EZSheets connects to the Google Sheets containing the fake blockchain and selects the first sheet in the spreadsheet (at index `0`). Note that you don't have permission to edit the Boringcoin Google Sheets, so open that URL in a web browser while logged in to your Google account and then select **File ▸ Make a Copy** to copy it to your Google Account. Then, replace the `'https://autbor.com/boringcoin'` string with a string of your Google Sheet's URL from the browser address bar:

```
# Change this URL to your copy of the Google
Sheet, or else you'll
# get a "The caller does not have permission"
error.
ss = ezsheets.Spreadsheet('https://
autbor.com/boringcoin')
sheet = ss.sheets[0]
```

Finally, you should get the number of rows in the sheet, increase it by one, and then fill in the columns of this row with the sender, recipient, and amount data:

```
# Add one more row to the sheet for a new
transaction:
sheet.rowCount += 1

sheet[1, sheet.rowCount] = sender
sheet[2, sheet.rowCount] = recipient
sheet[3, sheet.rowCount] = amount
```

Now when you run `python addBoringcoinTransaction.py "Al Sweigart" Eve 2000` from the terminal, the Google Sheets will have a new row with *Al Sweigart*, *Eve*, and *2000* added at the bottom. You can rerun the *auditBoringcoin.py* program to see the updated account balances of everyone in the cryptocurrency network.

The use of Google Sheets for our blockchain data structure is irresponsible, error prone, and a security catastrophe waiting to happen. This makes it on par with most marketed blockchain products. Don't miss out! Contact me to get in on this limited offer to buy Boringcoin before the pyramid scheme collapses!

Working with Google Sheets Quotas

Because Google Sheets is online, you can easily share sheets among multiple users who can all access the sheets simultaneously. However, this also means that reading and updating the sheets will be slower than reading and updating Excel files stored locally on your hard drive. In addition, Google Sheets limits how many read and write operations you can perform.

According to Google's developer guidelines, users are restricted to creating 250 new spreadsheets a day, and free Google accounts can perform a few hundred requests per minute. You can find Google's usage limits at *https://developers.google.com/sheets/api/limits*. Attempting to exceed this quota will raise the `googleapiclient.errors.HttpError` "Quota exceeded for quota group" exception. EZSheets will automatically catch this exception and retry the request. When this happens, the function calls to read or write data will take several seconds (or even a full minute or two) before they return. If the request continues to fail (which is possible if another script using the same credentials is also making requests), EZSheets will re-raise this exception.

This means that, on occasion, your EZSheets method calls may take several seconds before they return. If you want to view your API usage or increase your quota, go to the IAM & Admin Quotas page at *https://console.developers.google.com/iam-admin/quotas* to learn about paying for increased usage. If you'd rather just deal with the `HttpError` exceptions yourself, you can set `ezsheets.IGNORE_QUOTA` to `True`, and EZSheets' methods will raise these exceptions when it encounters them.

Summary

Google Sheets is a popular online spreadsheet application that runs in your browser. Using the EZSheets third-party package, you can download, create, read, and modify spreadsheets. EZSheets represents spreadsheets as `Spreadsheet` objects, each of which contains an ordered list of `Sheet` objects. Each sheet has columns and rows of data that you can read and update in several ways.

While Google Sheets makes sharing data and cooperative editing easy, its main disadvantage is speed: you must update spreadsheets with web requests, which can take a few seconds to execute. But for most purposes, this speed restriction won't affect Python scripts using EZSheets. Google Sheets also limits how often you can make changes.

For complete documentation of EZSheets' features, visit *https://ezsheets.readthedocs.io/*.

Practice Questions

1. What three files do you need for EZSheets to access Google Sheets?
2. What two types of objects does EZSheets have?
3. How can you create an Excel file from a Google Sheets spreadsheet?
4. How can you create a Google Sheets spreadsheet from an Excel file?
5. The `ss` variable contains a `Spreadsheet` object. What code will read data from the cell B2 in a sheet titled *Students*?
6. How can you find the column letters for column 999?
7. How can you find out how many rows and columns a sheet has?
8. How do you delete a spreadsheet? Is this deletion permanent?
9. What functions will create a new `Spreadsheet` object and a new `Sheet` object, respectively?

10. What would happen if, by making frequent read and write requests with EZSheets, you exceed your Google account's quota?

Practice Programs

For practice, write programs to do the following tasks.

Downloading Google Forms Data

I mentioned earlier that Google Forms allows you to create simple online forms that make it easy to collect information from people. The information entered into a form is stored in a Google Sheets spreadsheet. For this project, write a program that can automatically download the form information that users have submitted. Go to *https://docs.google.com/forms/* and start a new blank form. Add fields to the form that ask the user for a name and email address. Then, click the **Send** button in the upper right to get a link to your new form. Try to enter a few example responses into this form.

On the *Responses* tab of your form, click the green **Create Spreadsheet** button to create a Google Sheets spreadsheet that will hold the responses that users submit. You should see your example responses in the first rows of this spreadsheet. Then, write a Python script using EZSheets to collect a list of the email addresses on this spreadsheet.

Converting Spreadsheets to Other Formats

You can use Google Sheets to convert a spreadsheet file to other formats. Write a script that passes a submitted file to `upload()`. Once the spreadsheet has uploaded to Google Sheets, download it using `downloadAsExcel()`, `downloadAsODS()`, and other such functions to create a copy of the spreadsheet in these other formats.

Finding Mistakes in a Spreadsheet

After a long day at the bean-counting office, I've finished a spreadsheet with all the bean totals and uploaded them to Google Sheets. The spreadsheet is publicly viewable (but not editable). You can get this spreadsheet with the following code:

```
>>> import ezsheets
>>> ss =
ezsheets.Spreadsheet('1jDZEdvSIh4TmZxccyy0ZXr
H-ELlrwq8_YYiZrEOB4jg')
```

View the spreadsheet in your browser by going to *https://docs.google.com/spreadsheets/d/1jDZEdvSIh4TmZxccyy0ZXrH-ELlrwq8_YYiZrEOB4jg*. The columns of the first sheet in this spreadsheet are *BEANS PER JAR*, *JARS*, and *TOTAL BEANS*. The *TOTAL BEANS* column is the product of the numbers in the *BEANS PER JAR* and *JARS* columns. However, there is a mistake in one of the 15,000 rows in this sheet. That's too many rows to check by hand. Luckily, you can write a script that checks the totals.

As a hint, you can access the individual cells in a row with `ss.sheets[0].getRow(rowNum)`, where `ss` is the `Spreadsheet` object and `rowNum` is the row number. Remember that row numbers in Google Sheets begin at 1, not 0. The cell values will be strings, so you'll need to convert them to integers before your program can work with them. The expression `int(ss.sheets[0].getRow(2)[0]) * int(ss.sheets[0].getRow(2)[1]) == int(ss.sheets[0].getRow(2)[2])` evaluates to `True` if row 2 has the correct total. Put this code in a loop to identify which row in the sheet has the incorrect total.