

And since Python scripts are themselves just text files with the `.py` file extension, your Python programs can even generate other Python programs. You can then import these files into scripts.

```
>>> import myCats
>>> myCats.cats
[{'name': 'Zophie', 'desc': 'chubby'}, {'name': 'Pooka', 'desc': 'fluffy'}]
>>> myCats.cats[0]
{'name': 'Zophie', 'desc': 'chubby'}
>>> myCats.cats[0]['name']
'Zophie'
```

The benefit of creating a `.py` file (as opposed to saving variables with the `shelve` module) is that because it is a text file, the contents of the file can be read and modified by anyone with a simple text editor. For most applications, however, saving data using the `shelve` module is the preferred way to save variables to a file. Only basic data types such as integers, floats, strings, lists, and dictionaries can be written to a file as simple text. File objects, for example, cannot be encoded as text.

Project: Generating Random Quiz Files

Say you're a geography teacher with 35 students in your class and you want to give a pop quiz on US state capitals. Alas, your class has a few bad eggs in it, and you can't trust the students not to cheat. You'd like to randomize the order of questions so that each quiz is unique, making it impossible for anyone to crib answers from anyone else. Of course, doing this by hand would be a lengthy and boring affair. Fortunately, you know some Python.

Here is what the program does:

- Creates 35 different quizzes.
- Creates 50 multiple-choice questions for each quiz, in random order.
- Provides the correct answer and three random wrong answers for each question, in random order.
- Writes the quizzes to 35 text files.
- Writes the answer keys to 35 text files.

This means the code will need to do the following:

- Store the states and their capitals in a dictionary.
- Call `open()`, `write()`, and `close()` for the quiz and answer key text files.
- Use `random.shuffle()` to randomize the order of the questions and multiple-choice options.

Step 1: Store the Quiz Data in a Dictionary

The first step is to create a skeleton script and fill it with your quiz data. Create a file named *randomQuizGenerator.py*, and make it look like the following:

```
#!/python3
# randomQuizGenerator.py - Creates quizzes with questions and answers in
# random order, along with the answer key.

❶ import random

# The quiz data. Keys are states and values are their capitals.
❷ capitals = {'Alabama': 'Montgomery', 'Alaska': 'Juneau', 'Arizona': 'Phoenix',
'Arkansas': 'Little Rock', 'California': 'Sacramento', 'Colorado': 'Denver',
'Connecticut': 'Hartford', 'Delaware': 'Dover', 'Florida': 'Tallahassee',
'Georgia': 'Atlanta', 'Hawaii': 'Honolulu', 'Idaho': 'Boise', 'Illinois':
'Springfield', 'Indiana': 'Indianapolis', 'Iowa': 'Des Moines', 'Kansas':
'Topeka', 'Kentucky': 'Frankfort', 'Louisiana': 'Baton Rouge', 'Maine':
'Augusta', 'Maryland': 'Annapolis', 'Massachusetts': 'Boston', 'Michigan':
'Lansing', 'Minnesota': 'Saint Paul', 'Mississippi': 'Jackson', 'Missouri':
'Jefferson City', 'Montana': 'Helena', 'Nebraska': 'Lincoln', 'Nevada':
'Carson City', 'New Hampshire': 'Concord', 'New Jersey': 'Trenton', 'New
Mexico': 'Santa Fe', 'New York': 'Albany', 'North Carolina': 'Raleigh',
'North Dakota': 'Bismarck', 'Ohio': 'Columbus', 'Oklahoma': 'Oklahoma City',
'Oregon': 'Salem', 'Pennsylvania': 'Harrisburg', 'Rhode Island': 'Providence',
'South Carolina': 'Columbia', 'South Dakota': 'Pierre', 'Tennessee':
'Nashville', 'Texas': 'Austin', 'Utah': 'Salt Lake City', 'Vermont':
'Montpelier', 'Virginia': 'Richmond', 'Washington': 'Olympia', 'West
Virginia': 'Charleston', 'Wisconsin': 'Madison', 'Wyoming': 'Cheyenne'}

# Generate 35 quiz files.
❸ for quizNum in range(35):
    # TODO: Create the quiz and answer key files.

    # TODO: Write out the header for the quiz.

    # TODO: Shuffle the order of the states.

    # TODO: Loop through all 50 states, making a question for each.
```

Since this program will be randomly ordering the questions and answers, you'll need to import the random module ❶ to make use of its functions. The capitals variable ❷ contains a dictionary with US states as keys and their capitals as values. And since you want to create 35 quizzes, the code that actually generates the quiz and answer key files (marked with TODO comments for now) will go inside a for loop that loops 35 times ❸. (This number can be changed to generate any number of quiz files.)

Step 2: Create the Quiz File and Shuffle the Question Order

Now it's time to start filling in those TODOs.

The code in the loop will be repeated 35 times—once for each quiz—so you have to worry about only one quiz at a time within the loop. First you'll create the actual quiz file. It needs to have a unique filename and should also have some kind of standard header in it, with places for the student to fill in a name, date, and class period. Then you'll need to get a list of states in randomized order, which can be used later to create the questions and answers for the quiz.

Add the following lines of code to *randomQuizGenerator.py*:

```
#!/ python3
# randomQuizGenerator.py - Creates quizzes with questions and answers in
# random order, along with the answer key.

--snip--

# Generate 35 quiz files.
for quizNum in range(35):
    # Create the quiz and answer key files.
    ❶ quizFile = open('capitalsquiz%s.txt' % (quizNum + 1), 'w')
    ❷ answerKeyFile = open('capitalsquiz_answers%s.txt' % (quizNum + 1), 'w')

    # Write out the header for the quiz.
    ❸ quizFile.write('Name:\n\nDate:\n\nPeriod:\n\n')
    quizFile.write((' ' * 20) + 'State Capitals Quiz (Form %s)' % (quizNum + 1))
    quizFile.write('\n\n')

    # Shuffle the order of the states.
    states = list(capitals.keys())
    ❹ random.shuffle(states)

    # TODO: Loop through all 50 states, making a question for each.
```

The filenames for the quizzes will be *capitalsquiz<N>.txt*, where *<N>* is a unique number for the quiz that comes from *quizNum*, the for loop's counter. The answer key for *capitalsquiz<N>.txt* will be stored in a text file named *capitalsquiz_answers<N>.txt*. Each time through the loop, the *%s* placeholder in *'capitalsquiz%s.txt'* and *'capitalsquiz_answers%s.txt'* will be replaced by *(quizNum + 1)*, so the first quiz and answer key created will be *capitalsquiz1.txt* and *capitalsquiz_answers1.txt*. These files will be created with calls to the *open()* function at ❶ and ❷, with *'w'* as the second argument to open them in write mode.

The *write()* statements at ❸ create a quiz header for the student to fill out. Finally, a randomized list of US states is created with the help of the *random.shuffle()* function ❹, which randomly reorders the values in any list that is passed to it.

Step 3: Create the Answer Options

Now you need to generate the answer options for each question, which will be multiple choice from A to D. You'll need to create another for loop—this one to generate the content for each of the 50 questions on the quiz. Then there will be a third for loop nested inside to generate the multiple-choice options for each question. Make your code look like the following:

```
#!/ python3
# randomQuizGenerator.py - Creates quizzes with questions and answers in
# random order, along with the answer key.

--snip--

    # Loop through all 50 states, making a question for each.
    for questionNum in range(50):

        # Get right and wrong answers.
        ❶ correctAnswer = capitals[states[questionNum]]
        ❷ wrongAnswers = list(capitals.values())
        ❸ del wrongAnswers[wrongAnswers.index(correctAnswer)]
        ❹ wrongAnswers = random.sample(wrongAnswers, 3)
        ❺ answerOptions = wrongAnswers + [correctAnswer]
        ❻ random.shuffle(answerOptions)

        # TODO: Write the question and answer options to the quiz file.

        # TODO: Write the answer key to a file.
```

The correct answer is easy to get—it's stored as a value in the capitals dictionary ❶. This loop will loop through the states in the shuffled states list, from states[0] to states[49], find each state in capitals, and store that state's corresponding capital in correctAnswer.

The list of possible wrong answers is trickier. You can get it by duplicating *all* the values in the capitals dictionary ❷, deleting the correct answer ❸, and selecting three random values from this list ❹. The random.sample() function makes it easy to do this selection. Its first argument is the list you want to select from; the second argument is the number of values you want to select. The full list of answer options is the combination of these three wrong answers with the correct answers ❺. Finally, the answers need to be randomized ❻ so that the correct response isn't always choice D.

Step 4: Write Content to the Quiz and Answer Key Files

All that is left is to write the question to the quiz file and the answer to the answer key file. Make your code look like the following:

```
#!/ python3
# randomQuizGenerator.py - Creates quizzes with questions and answers in
# random order, along with the answer key.

--snip--
```

```

# Loop through all 50 states, making a question for each.
for questionNum in range(50):
    --snip--

    # Write the question and the answer options to the quiz file.
    quizFile.write('%s. What is the capital of %s?\n' % (questionNum + 1,
        states[questionNum]))
❶ for i in range(4):
❷     quizFile.write('    %s. %s\n' % ('ABCD'[i], answerOptions[i]))
    quizFile.write('\n')

    # Write the answer key to a file.
❸     answerKeyFile.write('%s. %s\n' % (questionNum + 1, 'ABCD'[
        answerOptions.index(correctAnswer)]))
quizFile.close()
answerKeyFile.close()

```

A for loop that goes through integers 0 to 3 will write the answer options in the `answerOptions` list ❶. The expression `'ABCD'[i]` at ❷ treats the string `'ABCD'` as an array and will evaluate to `'A'`, `'B'`, `'C'`, and then `'D'` on each respective iteration through the loop.

In the final line ❸, the expression `answerOptions.index(correctAnswer)` will find the integer index of the correct answer in the randomly ordered answer options, and `'ABCD'[answerOptions.index(correctAnswer)]` will evaluate to the correct answer's letter to be written to the answer key file.

After you run the program, this is how your *capitalsquiz1.txt* file will look, though of course your questions and answer options may be different from those shown here, depending on the outcome of your `random.shuffle()` calls:

Name:

Date:

Period:

State Capitals Quiz (Form 1)

1. What is the capital of West Virginia?
 - A. Hartford
 - B. Santa Fe
 - C. Harrisburg
 - D. Charleston

2. What is the capital of Colorado?
 - A. Raleigh
 - B. Harrisburg
 - C. Denver
 - D. Lincoln

--snip--

The corresponding *capitalsquiz_answers1.txt* text file will look like this:

```
1. D
2. C
3. A
4. C
--snip--
```

Project: Multiclipboard

Say you have the boring task of filling out many forms in a web page or software with several text fields. The clipboard saves you from typing the same text over and over again. But only one thing can be on the clipboard at a time. If you have several different pieces of text that you need to copy and paste, you have to keep highlighting and copying the same few things over and over again.

You can write a Python program to keep track of multiple pieces of text. This “multiclipboard” will be named *mcb.pyw* (since “mcb” is shorter to type than “multiclipboard”). The *.pyw* extension means that Python won’t show a Terminal window when it runs this program. (See Appendix B for more details.)

The program will save each piece of clipboard text under a keyword. For example, when you run `py mcb.pyw save spam`, the current contents of the clipboard will be saved with the keyword *spam*. This text can later be loaded to the clipboard again by running `py mcb.pyw spam`. And if the user forgets what keywords they have, they can run `py mcb.pyw list` to copy a list of all keywords to the clipboard.

Here’s what the program does:

- The command line argument for the keyword is checked.
- If the argument is `save`, then the clipboard contents are saved to the keyword.
- If the argument is `list`, then all the keywords are copied to the clipboard.
- Otherwise, the text for the keyword is copied to the keyboard.

This means the code will need to do the following:

- Read the command line arguments from `sys.argv`.
- Read and write to the clipboard.
- Save and load to a shelf file.

If you use Windows, you can easily run this script from the Run... window by creating a batch file named *mcb.bat* with the following content:

```
@pyw.exe C:\Python34\mcb.pyw %*
```

Step 1: Comments and Shelf Setup

Let's start by making a skeleton script with some comments and basic setup. Make your code look like the following:

```
#!/ python3
# mcb.pyw - Saves and loads pieces of text to the clipboard.
❶ # Usage: py.exe mcb.pyw save <keyword> - Saves clipboard to keyword.
#       py.exe mcb.pyw <keyword> - Loads keyword to clipboard.
#       py.exe mcb.pyw list - Loads all keywords to clipboard.

❷ import shelve, pyperclip, sys

❸ mcbShelf = shelve.open('mcb')

# TODO: Save clipboard content.

# TODO: List keywords and load content.

mcbShelf.close()
```

It's common practice to put general usage information in comments at the top of the file ❶. If you ever forget how to run your script, you can always look at these comments for a reminder. Then you import your modules ❷. Copying and pasting will require the `pyperclip` module, and reading the command line arguments will require the `sys` module. The `shelve` module will also come in handy: Whenever the user wants to save a new piece of clipboard text, you'll save it to a shelf file. Then, when the user wants to paste the text back to their clipboard, you'll open the shelf file and load it back into your program. The shelf file will be named with the prefix `mcb` ❸.

Step 2: Save Clipboard Content with a Keyword

The program does different things depending on whether the user wants to save text to a keyword, load text into the clipboard, or list all the existing keywords. Let's deal with that first case. Make your code look like the following:

```
#!/ python3
# mcb.pyw - Saves and loads pieces of text to the clipboard.
--snip--

# Save clipboard content.
❶ if len(sys.argv) == 3 and sys.argv[1].lower() == 'save':
❷     mcbShelf[sys.argv[2]] = pyperclip.paste()
    elif len(sys.argv) == 2:
❸     # TODO: List keywords and load content.

mcbShelf.close()
```

If the first command line argument (which will always be at index 1 of the `sys.argv` list) is 'save' ❶, the second command line argument is the keyword for the current content of the clipboard. The keyword will be used as the key for `mcbShelf`, and the value will be the text currently on the clipboard ❷.

If there is only one command line argument, you will assume it is either 'list' or a keyword to load content onto the clipboard. You will implement that code later. For now, just put a `TODO` comment there ❸.

Step 3: List Keywords and Load a Keyword's Content

Finally, let's implement the two remaining cases: The user wants to load clipboard text in from a keyword, or they want a list of all available keywords. Make your code look like the following:

```
#!/ python3
# mcb.pyw - Saves and loads pieces of text to the clipboard.
--snip--

# Save clipboard content.
if len(sys.argv) == 3 and sys.argv[1].lower() == 'save':
    mcbShelf[sys.argv[2]] = pyperclip.paste()
elif len(sys.argv) == 2:
    # List keywords and load content.
    ❶ if sys.argv[1].lower() == 'list':
    ❷     pyperclip.copy(str(list(mcbShelf.keys())))
    elif sys.argv[1] in mcbShelf:
    ❸     pyperclip.copy(mcbShelf[sys.argv[1]])

mcbShelf.close()
```

If there is only one command line argument, first let's check whether it's 'list' ❶. If so, a string representation of the list of shelf keys will be copied to the clipboard ❷. The user can paste this list into an open text editor to read it.

Otherwise, you can assume the command line argument is a keyword. If this keyword exists in the `mcbShelf` shelf as a key, you can load the value onto the clipboard ❸.

And that's it! Launching this program has different steps depending on what operating system your computer uses. See Appendix B for details for your operating system.

Recall the password locker program you created in Chapter 6 that stored the passwords in a dictionary. Updating the passwords required changing the source code of the program. This isn't ideal because average users don't feel comfortable changing source code to update their software. Also, every time you modify the source code to a program, you run the risk of accidentally introducing new bugs. By storing the data for a program in a different place than the code, you can make your programs easier for others to use and more resistant to bugs.