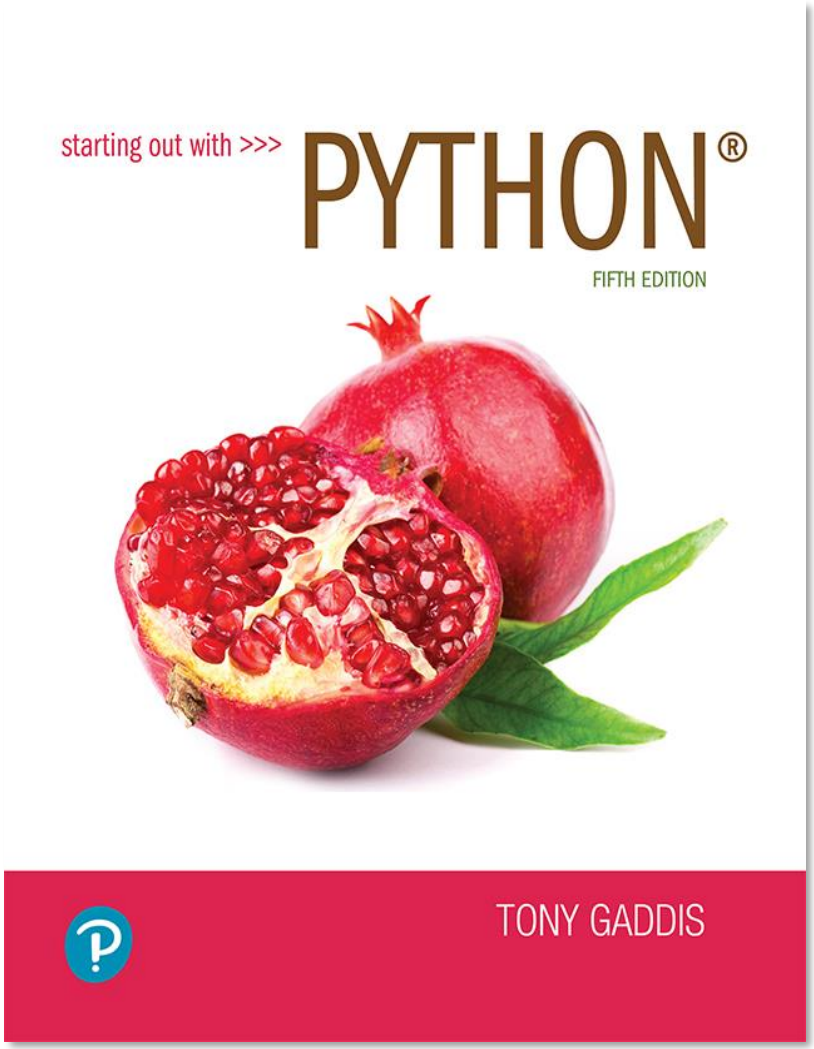
Starting out with Python

Fifth Edition



Chapter 6

Files and Exceptions

Topics

- Introduction to File Input and Output
- Using Loops to Process Files
- Processing Records
- Exceptions

Introduction to File Input and Output (1 of 4)

- For program to retain data between the times it is run, you must save the data
  - Data is saved to a file, typically on computer disk
  - Saved data can be retrieved and used at a later time
- “Writing data to”: saving data on a file
- Output file: a file that data is written to

Introduction to File Input and Output (2 of 4)

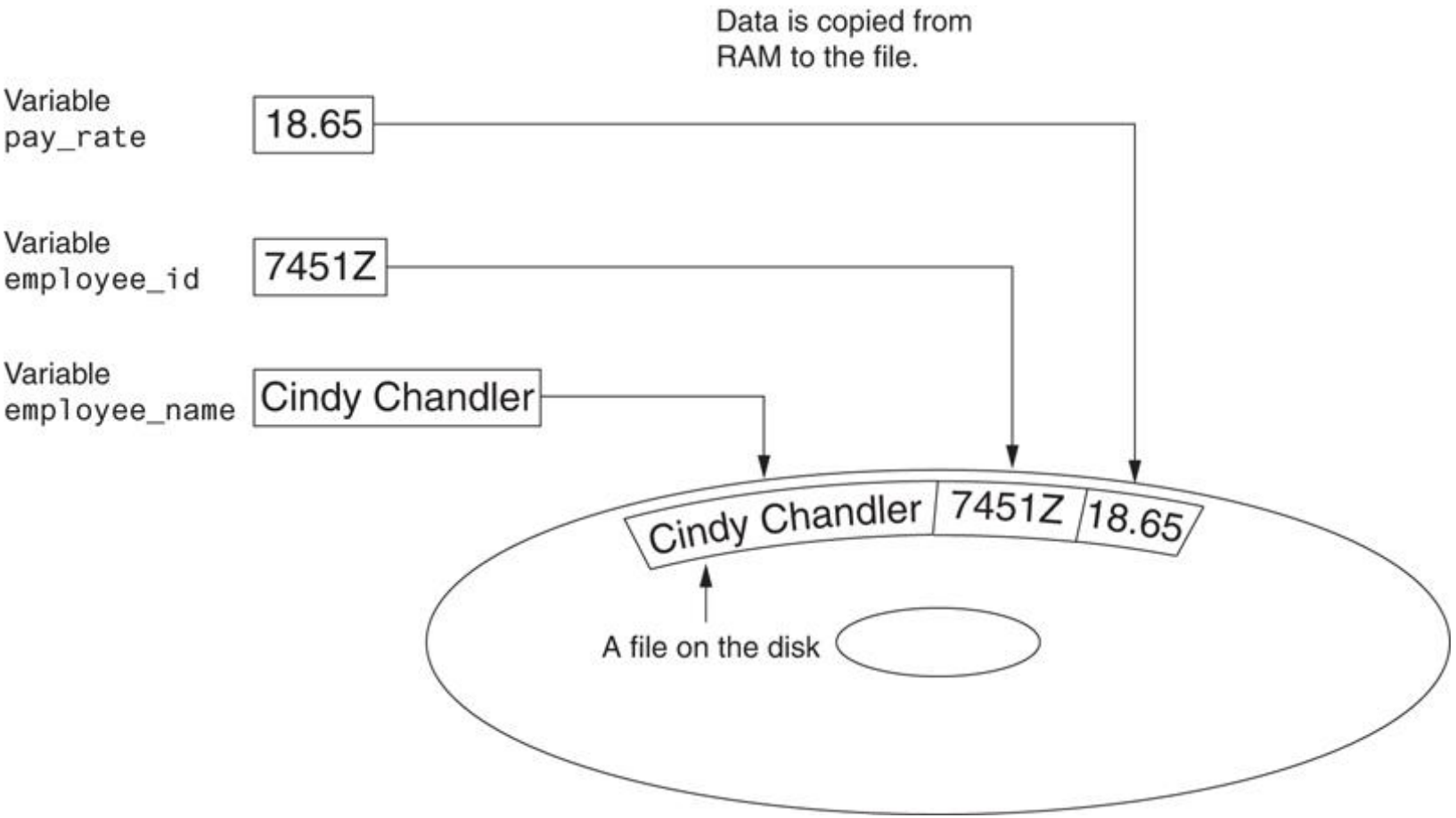


Figure 6-1 Writing data to a file

Introduction to File Input and Output (3 of 4)

- "Reading data from": process of retrieving data from a file
- Input file: a file from which data is read
- Three steps when a program uses a file
  - Open the file
  - Process the file
  - Close the file

Introduction to File Input and Output (4 of 4)

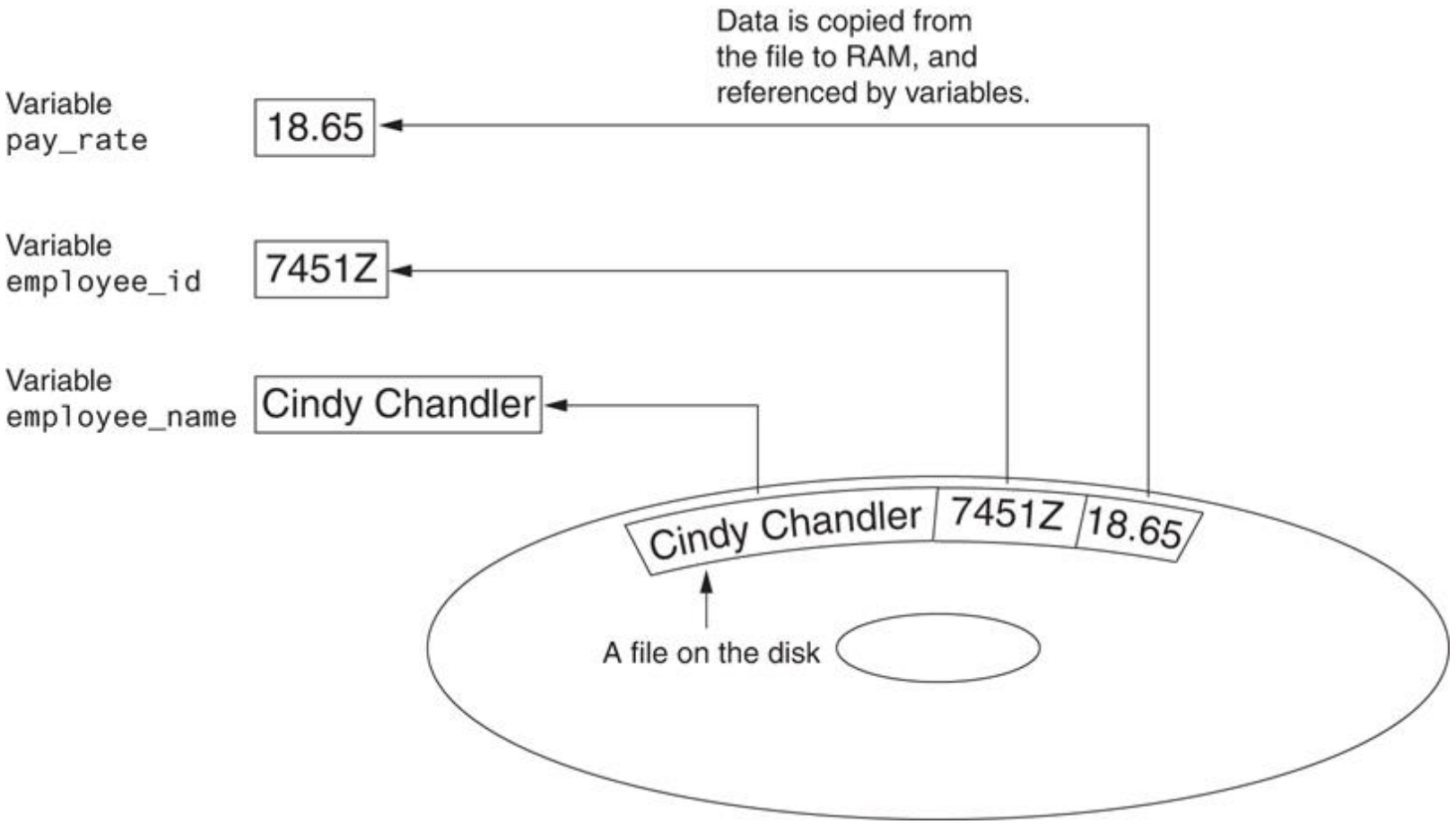


Figure 6-2 Reading data from a file

Types of Files and File Access Methods

- In general, two types of files
  - Text file: contains data that has been encoded as text
  - Binary file: contains data that has not been converted to text
- Two ways to access data stored in file
  - Sequential access: file read sequentially from beginning to end, can't skip ahead
  - Direct access: can jump directly to any piece of data in the file

Filenames and File Objects (1 of 2)

- Filename extensions: short sequences of characters that appear at the end of a filename preceded by a period
  - Extension indicates type of data stored in the file
- File object: object associated with a specific file
  - Provides a way for a program to work with the file: file object referenced by a variable

Filenames and File Objects (2 of 2)

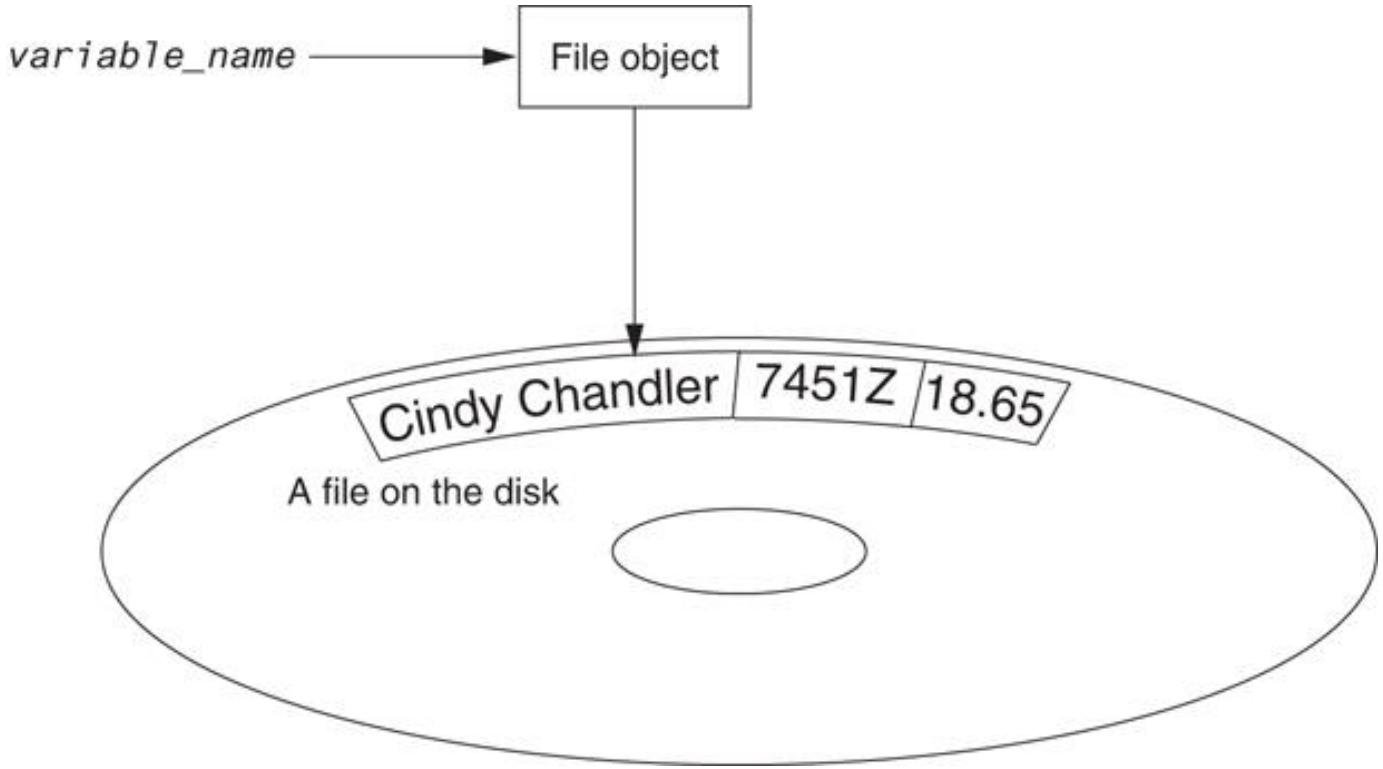


Figure 6-4 A variable name references a file object that is associated with a file

Opening a File

- `open` function: used to open a file
  - Creates a file object and associates it with a file on the disk
  - General format:
  - *`file_object`* `= open(`*`filename, mode`*`)`
- Mode: string specifying how the file will be opened
  - Example: reading only (`'r'`), writing (`'w'`), and appending (`'a'`)

Specifying the Location of a File

- If `open` function receives a filename that does not contain a path, assumes that file is in same directory as program
- If program is running and file is created, it is created in the same directory as the program
  - Can specify alternative path and file name in the `open` function argument
    - Prefix the path string literal with the letter `r`

Writing Data to a File

- Method: a function that belongs to an object
  - Performs operations using that object
- File object's `write` method used to write data to the file
  - Format: *`file_variable`*`.write(`*`string`*`)`
- File should be closed using file object `close` method
  - Format: *`file_variable`*`.close()`

Reading Data From a File

- `read` method: file object method that reads entire file contents into memory
  - Only works if file has been opened for reading
  - Contents returned as a string
- `readline` method: file object method that reads a line from the file
  - Line returned as a string, including `'\n'`
- Read position: marks the location of the next item to be read from a file

Concatenating a Newline to and Stripping it From a String

- In most cases, data items written to a file are values referenced by variables
  - Usually necessary to concatenate a `'\n'` to data before writing it
    - Carried out using the `+` operator in the argument of the `write` method
- In many cases need to remove `'\n'` from string after it is read from a file
  - `rstrip` method: string method that strips specific characters from end of the string

Appending Data to an Existing File

- When open file with `'w'` mode, if the file already exists it is overwritten
- To append data to a file use the `'a'`mode
  - If file exists, it is not erased, and if it does not exist it is created
  - Data is written to the file at the end of the current contents

Writing and Reading Numeric Data

- Numbers must be converted to strings before they are written to a file
- `str` function: converts value to string
- Number are read from a text file as strings
  - Must be converted to numeric type in order to perform mathematical operations
  - Use `int` and `float` functions to convert string to numeric value

Using Loops to Process Files (1 of 2)

- Files typically used to hold large amounts of data
  - Loop typically involved in reading from and writing to a file
- Often the number of items stored in file is unknown
  - The `readline` method uses an empty string as a sentinel when end of file is reached
    - Can write a while loop with the condition

      `while line != ''`

Using Loops to Process Files (2 of 2)

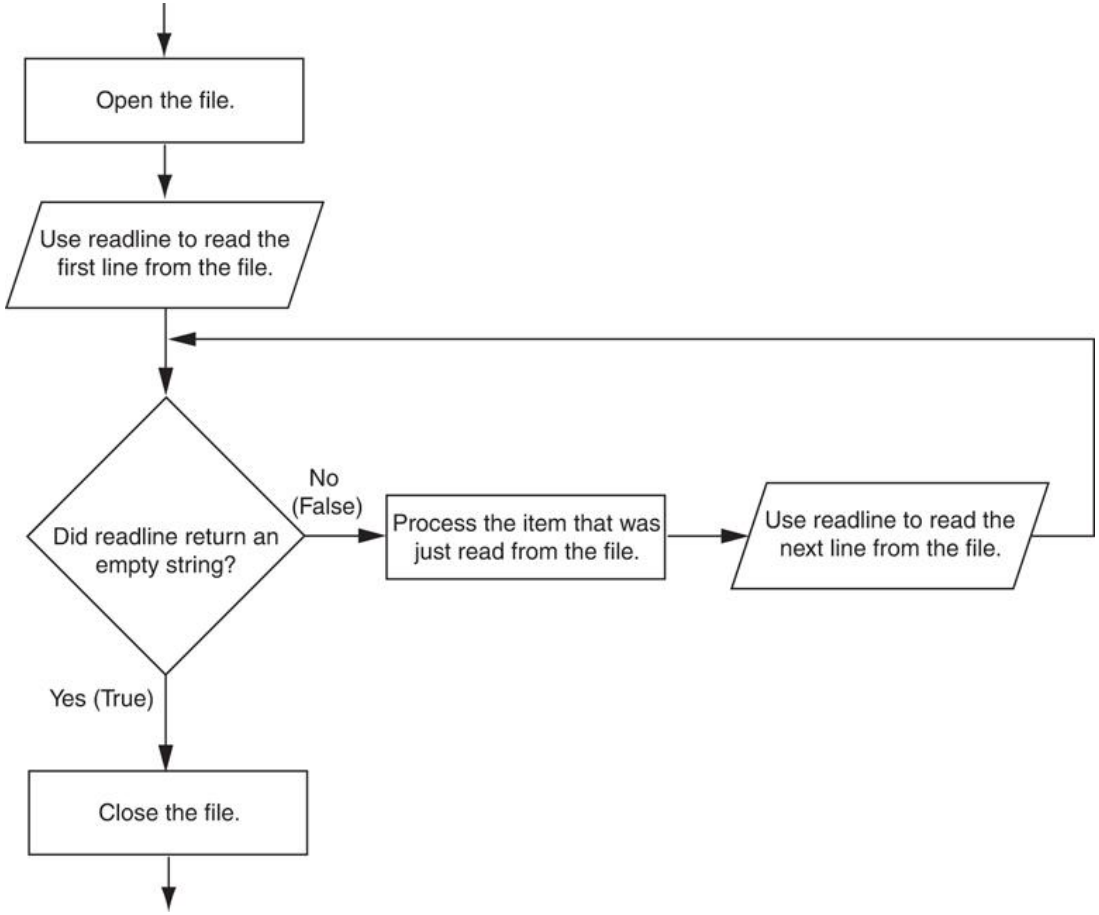


Figure 6-17 General logic for detecting the end of a file

Using Python's `for` Loop to Read Lines

- Python allows the programmer to write a `for` loop that automatically reads lines in a file and stops when end of file is reached
  - Format: `for` *`line`* `in` *`file_object`*`:`
  - `statements`
  - The loop iterates once over each line in the file

Processing Records (1 of 2)

- Record: set of data that describes one item
- Field: single piece of data within a record
- Write record to sequential access file by writing the fields one after the other
- Read record from sequential access file by reading each field until record complete

Processing Records (2 of 2)

- When working with records, it is also important to be able to:
  - Add records
  - Display records
  - Search for a specific record
  - Modify records
  - Delete records

Exceptions (1 of 4)

- Exception: error that occurs while a program is running
  - Usually causes program to abruptly halt
- Traceback: error message that gives information regarding line numbers that caused the exception
  - Indicates the type of exception and brief description of the error that caused exception to be raised

Exceptions (2 of 4)

- Many exceptions can be prevented by careful coding
  - Example: input validation
  - Usually involve a simple decision construct
- Some exceptions cannot be avoided by careful coding
  - Examples
    - Trying to convert non-numeric string to an integer
    - Trying to open for reading a file that doesn't exist

Exceptions (3 of 4)

- Exception handler: code that responds when exceptions are raised and prevents program from crashing
  - In Python, written as `try/except` statement
    - General format: `try:`

```
        statements
    except exceptionName:
        statements
```

    - Try suite: statements that can potentially raise an exception
    - Handler: statements contained in `except` block

Exceptions (4 of 4)

- If statement in try suite raises exception:
  - Exception specified in except clause:
    - Handler immediately following except clause executes
    - Continue program after try/except statement
  - Other exceptions:
    - Program halts with traceback error message
- If no exception is raised, handlers are skipped

Handling Multiple Exceptions

- Often code in try suite can throw more than one type of exception
  - Need to write `except` clause for each type of exception that needs to be handled
- An `except` clause that does not list a specific exception will handle any exception that is raised in the try suite
  - Should always be last in a series of `except` clauses

Displaying an Exception's Default Error Message

- Exception object: object created in memory when an exception is thrown
  - Usually contains default error message pertaining to the exception
  - Can assign the exception object to a variable in an `except` clause
    - Example: `except ValueErroraserr:`
  - Can pass exception object variable to `print` function to display the default error message

The `else` Clause

- `try/except` statement may include an optional `else` clause, which appears after all the `except` clauses
  - Aligned with `try` and `except` clauses
  - Syntax similar to `else` clause in decision structure
  - Else suite: block of statements executed after statements in try suite, only if no exceptions were raised
    - If exception was raised, the else suite is skipped

The `finally` Clause

- `try/except` statement may include an optional `finally` clause, which appears after all the `except` clauses
  - Aligned with `try` and `except` clauses
  - General format: `finally:`
  - `    statements`
  - Finally suite: block of statements after the `finally` clause
    - Execute whether an exception occurs or not
    - Purpose is to perform cleanup before exiting

What If an Exception Is Not Handled?

- Two ways for exception to go unhandled:
  - No except clause specifying exception of the right type
  - Exception raised outside a try suite
- In both cases, exception will cause the program to halt
  - Python documentation provides information about exceptions that can be raised by different functions

Summary

- This chapter covered:
  - Types of files and file access methods
  - Filenames and file objects
  - Writing data to a file
  - Reading data from a file and determining when the end of the file is reached
  - Processing records
  - Exceptions, including:
    - Traceback messages
    - Handling exceptions