

Topics

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

Introduction to File Input and Output

- 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 (cont'd.)

- “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

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

Filename and File Objects

- 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

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

- 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 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

- 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 (cont'd.)

- 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

- 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 (cont'd.)

- 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 (cont'd.)

- 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 (cont'd.)

- 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 ValueError as err:`
 - 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