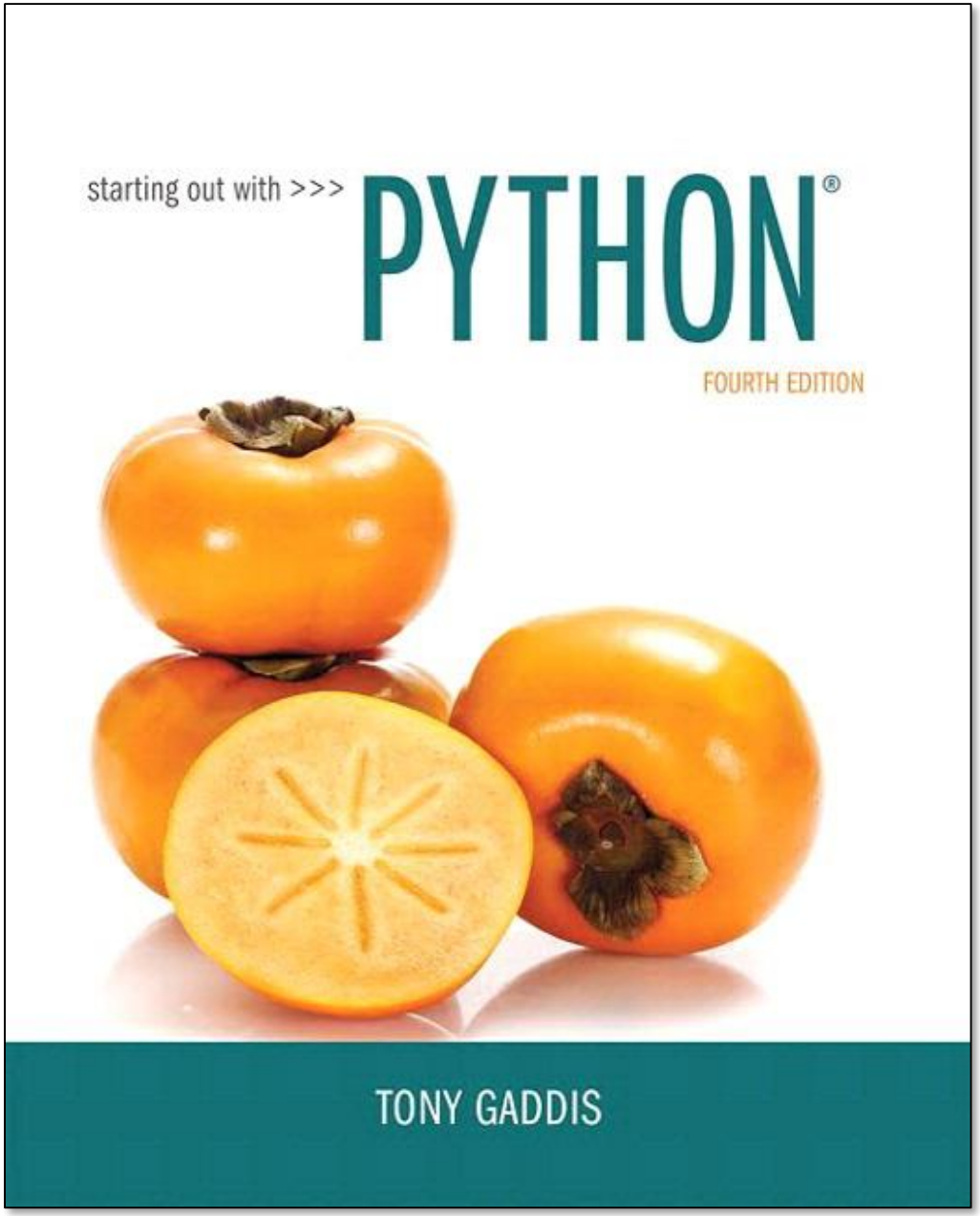
CHAPTER 6

Files and Exceptions



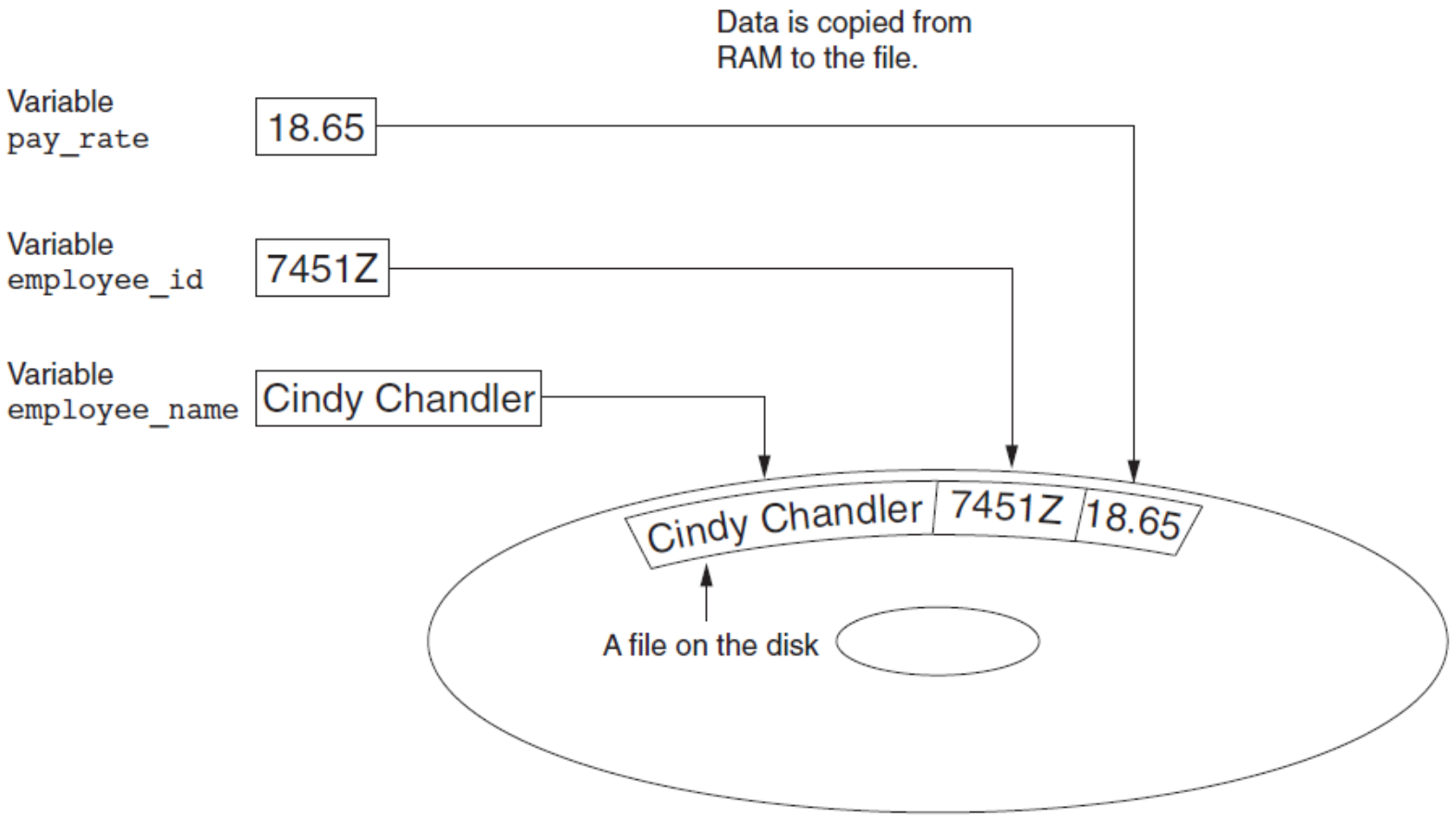
Topics

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

Introduction to File Input and Output

- **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
    - Word processors
    - Spread sheets
- **"Writing data to": saving data on a file**
- **Output file: a file that data is written to**

Figure 6-1 Writing data to a file

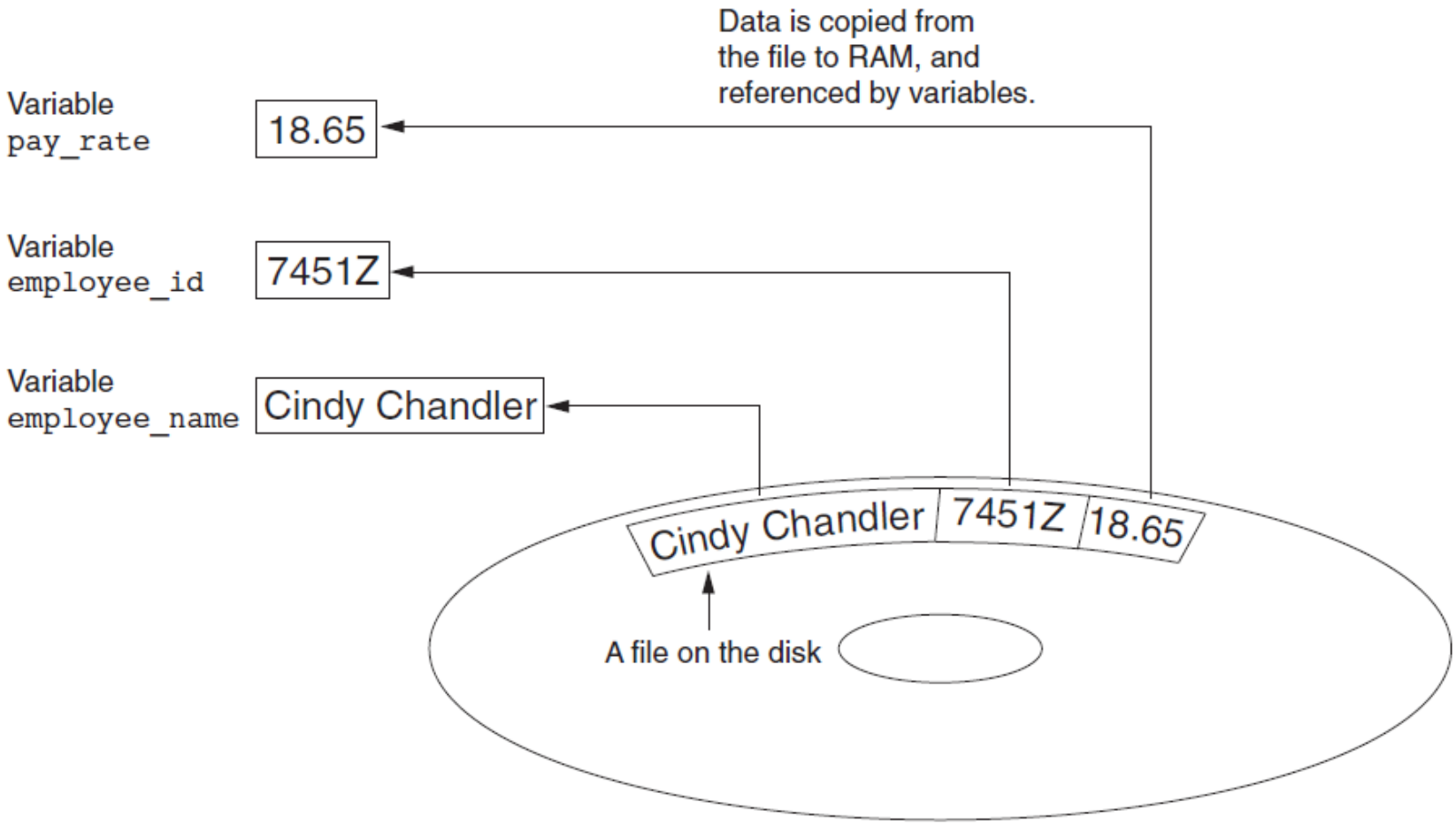


- When a piece of data is read from a file, it is copied to the ram and referenced by a variable

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**
  1. Open the file
  2. Process the file
  3. Close the file

Figure 6-2 Reading data from a file



Types of Files

- **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
  - Python allows to work with both
  - We will deal only with text files

File Access Methods

- **Two ways to access data stored in file**
  - Sequential access: file read sequentially from beginning to end, can't skip ahead
    - You have to read all the file if you will access a piece of data at the end of the file
    - Similar to the way older cassette tap players work
  - Direct access: can jump directly to any piece of data in the file
    - Known as random access file

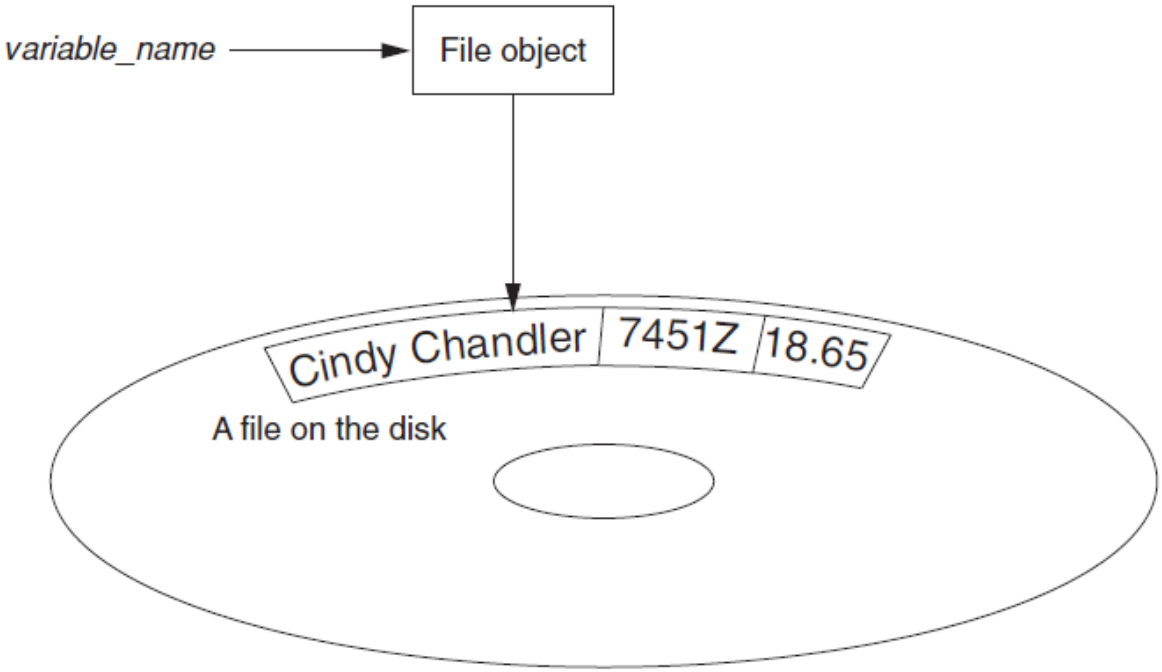
We will use sequential access

Filenames 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
  - .jpg, .txt.docx
- **File object: object associated with a specific file**
  - A program must create a file object in memory to work with the file
  - A file object referenced by a variable

Filenames and File Objects (cont'd.)

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**
  1. reading only (`'r'`)
  2. writing (`'w'`)
  3. appending (`'a'`)

Open File Modes

1. **Reading only (`'r'`)**
   - The file can not be changed or written to
2. **Writing (`'w'`)**
   - If the file already exists, erase it
   - If the file does not exit, create it
3. **Appending (`'a'`)**
   - If the file already exists, all data to be written to the file will be appended
   - If the file does not exit, create it

Specifying Locations of Files

1. **If you specify just a filename that does not contain a path, open function assumes that file is in same directory as program**
   - test_file = open('test.txt','w')
2. **Can specify alternative path and file name**
   - Prefix the path string literal with the letter `r` particularly in windows
   - test_file = open(r'C:\users\kxr051\temp\test.txt','w')

Writing Data to a File

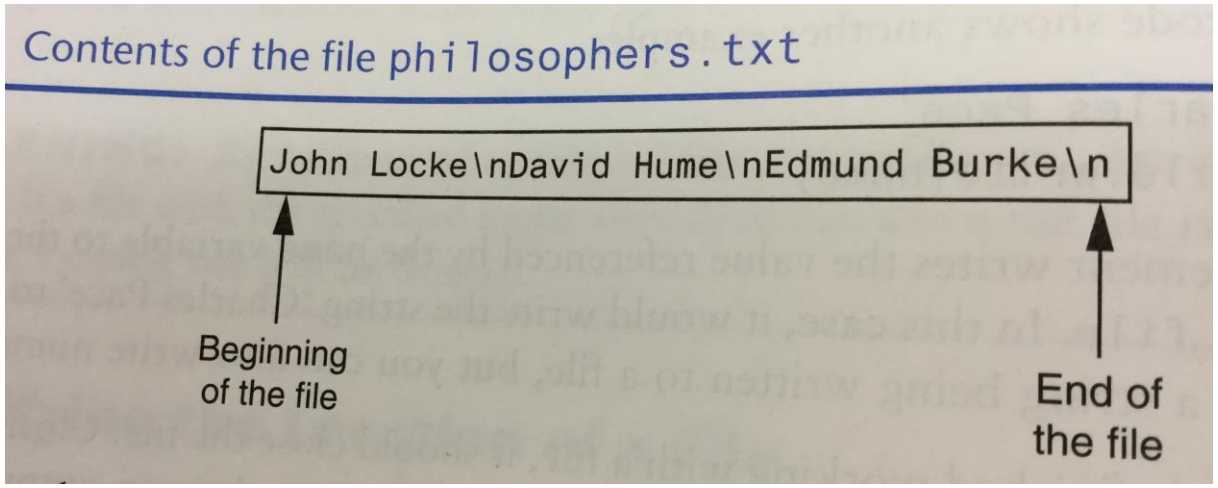
- **Method: a function that belongs to an object**
  - Performs operations using that object
- **File object's `write` method used to write data to the file**
  - Format: *`file_variable`*`.write(`*`string`*`)`
  - `customer_file.write('Charles Pace')`
- **File should be closed using file object `close`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

file_write.py

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
  - *`string=file_object.read()`*

file_read.py



Reading Data From a File

- **`readline` method: file object method that reads a line from the file**
  - *`string=file_object.readline()`*
  - Line returned as a string, including `'\n'`
  - Advances the read position index
  - Why print function prints two new lines?
- **Read position: marks the location of the next item to be read from a file**

line_read.py

Concatenating a Newline to and Stripping it From a String

- **Usually it is necessary to concatenate a '\n' to data before writing it**
  - Carried out using the `+` operator in the argument of the `write` method

write_names.py

- **Removing `'\n'` from string after it is read from a file**
  - `rstrip` method: string method that strips specific characters from end of the string

strip_newline.py

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

file_append.py

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**

write_numbers.py

  - Must be converted to numeric type in order to perform mathematical operations
  - Use `int` and `float` functions to convert string to numeric value

read_numbers.py

Using Loops to Process Files

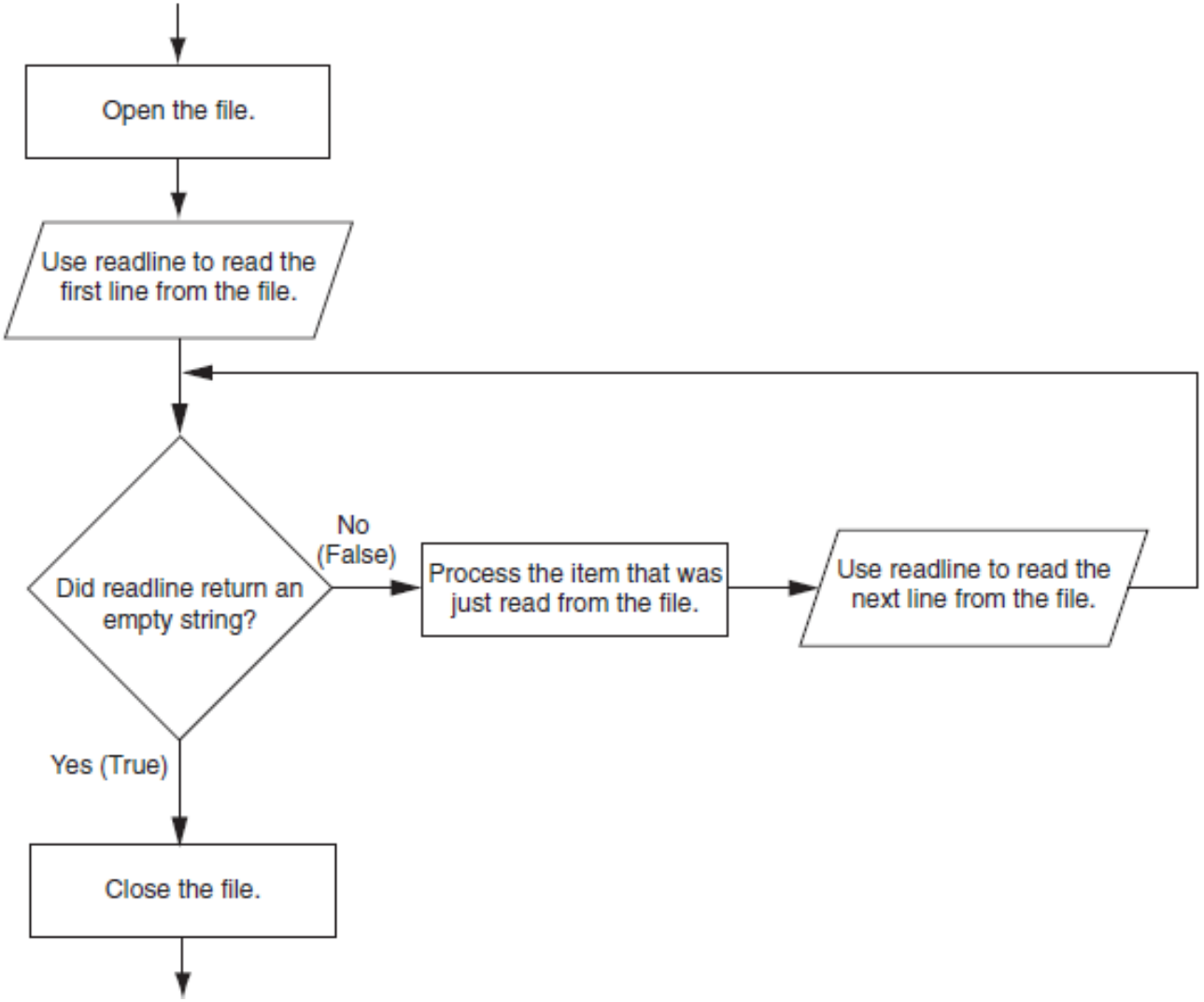
- **Files typically used to hold large amounts of data**
  - Loop typically involved in reading from and writing to a file

write_sales.py

- **What if the number of items (lines) stored in file is unknown**
  - Use while loop
  - 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 != ''
```

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



read_sales.py

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

read_sales2.py

Records

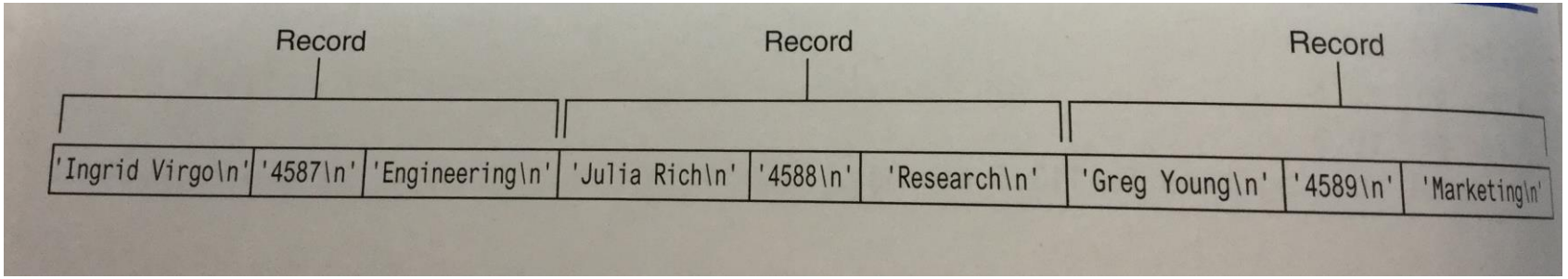
- **Record: complete set of data that describes one item**
- **Field: single piece of data within a record**

ID No.	*Name*	*D.o.B.*	*Phone*	*Class*	*Tutor*	*Room*
356	Jess	3 Mar 1995	7564356	5B	Mr Noggin	56
412	Hamad	12 Nov 1994	7465846	5B	Mr Noggin	56
459	Sita	9 Jan 1994	8565634	6Y	Ms Take	18
502	Hamad	3 Mar 1995	6554546	5B	Mr Noggin	56

One **Record**

Processing Records

- **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**



save_emp_records.py

read_emp_records.py

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
  - type of exception
  - 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

division.py

division2.py

- **Some exceptions cannot be avoided by careful coding**
  - Examples
    - Trying to convert non-numeric string to an integer
      - int('forty')
    - 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**

gross_pay1
gross_pay2

Passing non-numeric value to int() function
Error Name: ValueError

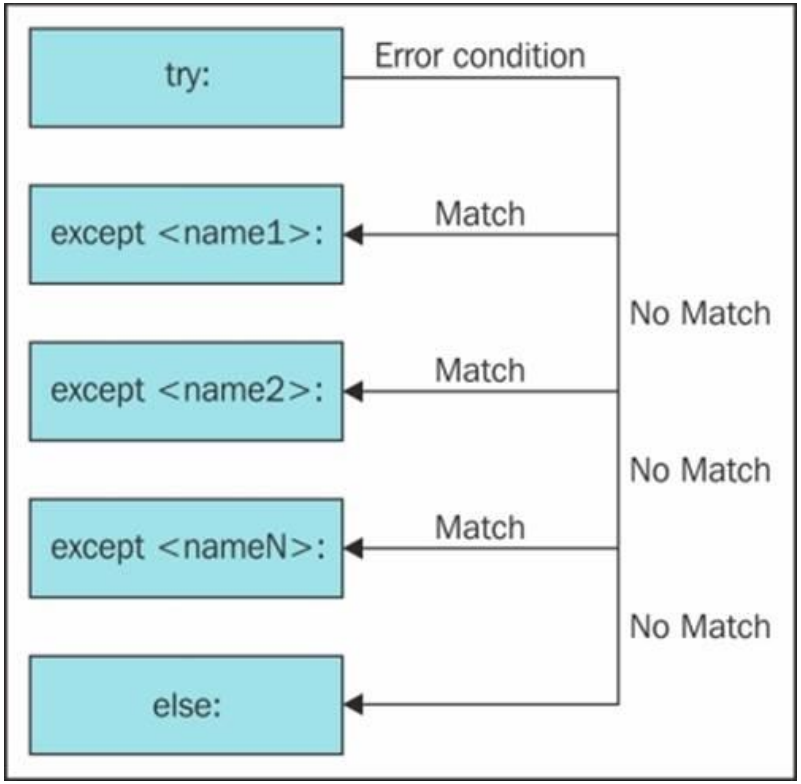
Reading non existing file
Error Name: IOError

display_file.py
display_file2.py

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

sales_report1.py



Handling Multiple Exceptions

- **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 Why?

sales_report2.py

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

gross_pay3.py

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

sales_report4.py

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