io — Text, Binary, and Raw Stream I/O Tools

Purpose: Implements file I/O and provides classes for working with buffers using file-like API.

The `io` module implements the classes behind the interpreter's built-in `open()` for file-based input and output operations. The classes are decomposed in such a way that they can be recombined for alternate purposes, for example to enable writing Unicode data to a network socket.

In-memory Streams

`StringIO` provides a convenient means of working with text in memory using the file API (`read()`, `write()`, etc.). Using `StringIO` to build large strings can offer performance savings over some other string concatenation techniques in some cases. In-memory stream buffers are also useful for testing, where writing to a real file on disk may slow down the test suite.

Here are a few standard examples of using `StringIO` buffers:

```
# io_stringio.py

import io

# Writing to a buffer
output = io.StringIO()
output.write('This goes into the buffer. ')
print('And so does this.', file=output)

# Retrieve the value written
print(output.getvalue())

output.close()  # discard buffer memory

# Initialize a read buffer
input = io.StringIO('Inital value for read buffer')

# Read from the buffer
print(input.read())
```

This example uses `read()`, but the `readline()` and `readlines()` methods are also available. The `StringIO` class also provides a `seek()` method for jumping around in a buffer while reading, which can be useful for rewinding if a look-ahead parsing algorithm is being used.

```
$ python3 io_stringio.py

This goes into the buffer. And so does this.

Inital value for read buffer
```

To work with raw bytes instead of Unicode text, use `BytesIO`.

```
# io_bytesio.py

import io

# Writing to a buffer
output = io.BytesIO()
output.write('This goes into the buffer. '.encode('utf-8'))
output.write('ÁÇÊ'.encode('utf-8'))

# Retrieve the value written
print(output.getvalue())

output.close()  # discard buffer memory

# Initialize a read buffer
```

```
# Initialize a read buffer
input = io.BytesIO(b'Inital value for read buffer')

# Read from the buffer
print(input.read())
```

The values written to the `BytesIO` must be `bytes` rather than `str`.

```
$ python3 io_bytesio.py

b'This goes into the buffer. \xc3\x81\xc3\x87\xc3\x8a'
b'Inital value for read buffer'
```

Wrapping Byte Streams for Text Data

Raw byte streams such as sockets can be wrapped with a layer to handle string encoding and decoding, making it easier to use them with text data. The `TextIOWrapper` class supports writing as well as reading. The `write_through` argument disables buffering, and flushes all data written to the wrapper through to the underlying buffer immediately.

```
# io_textiowrapper.py

import io

# Writing to a buffer
output = io.BytesIO()
wrapper = io.TextIOWrapper(
    output,
    encoding='utf-8',
    write_through=True,
)
wrapper.write('This goes into the buffer. ')
wrapper.write('ÁÇÊ')

# Retrieve the value written
print(output.getvalue())

output.close()  # discard buffer memory

# Initialize a read buffer
input = io.BytesIO(
    b'Inital value for read buffer with unicode characters ' +
    'ÁÇÊ'.encode('utf-8')
)
wrapper = io.TextIOWrapper(input, encoding='utf-8')

# Read from the buffer
print(wrapper.read())
```

This example uses a `BytesIO` instance as the stream. Examples for `bz2`, `http.server`, and `subprocess` demonstrate using `TextIOWrapper` with other types of file-like objects.

```
$ python3 io_textiowrapper.py

b'This goes into the buffer. \xc3\x81\xc3\x87\xc3\x8a'
Inital value for read buffer with unicode characters ÁÇÊ
```

See also

- Standard library documentation for io
- HTTP POST example – Uses the `detach()` of `TextIOWrapper` to manage the wrapper separately from the wrapped socket.
- Efficient String Concatenation in Python – Examines various methods of combining strings and their relative merits.

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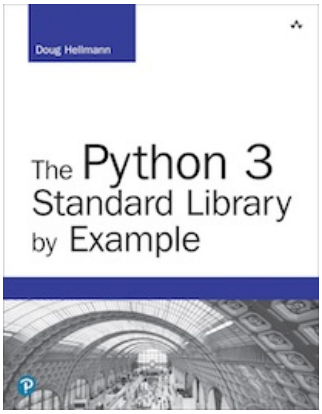

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The output from all the example programs from PyMOTW-3 has been generated with Python 3.7.1, unless otherwise noted. Some of the features described here may not be available in earlier versions of Python.

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