Introduction to Programming Language (ITP101)

Unit 8: Files

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...So Far in Python & Today...

- Core Python objects:
  - Functions
  - Lists
  - Tuples
  - Dictionaries
  - Sets
  - Strings
- Exception handling and debugging
  - `try...except...[else]`
  - `try...finally`
  - `assert`
  - The `pdb` debugger

Today:

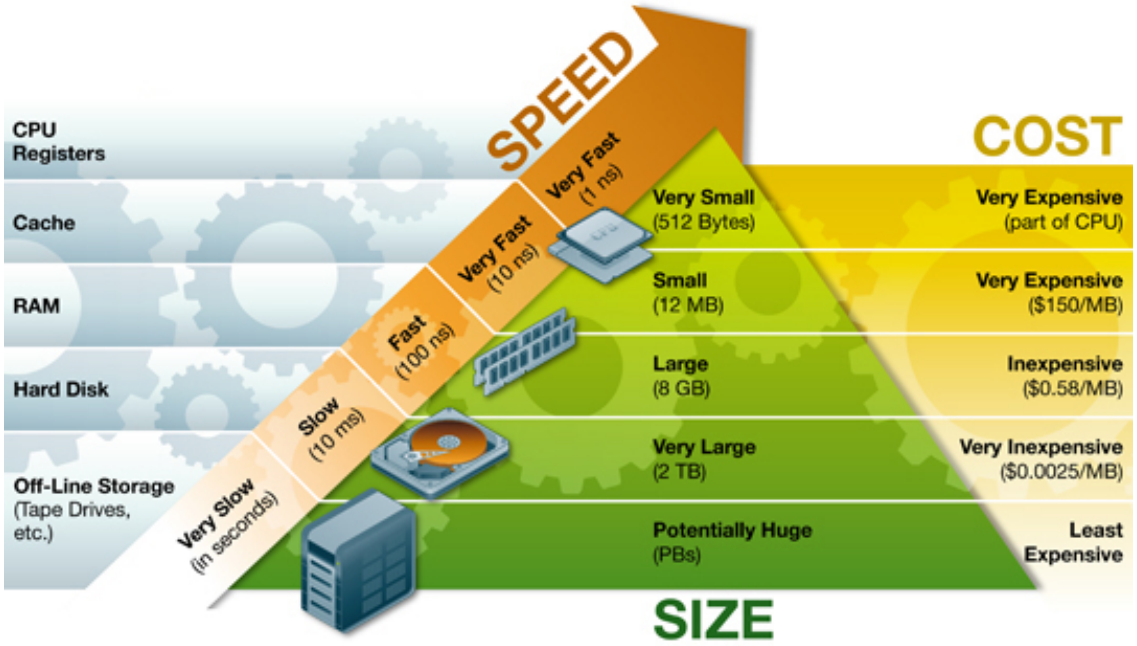
- File handling

File

- A sequence of bytes stored on your computer or network.
- A named storage object managed by your OS.
- File objects are Python code's interface to external files on your system.
- Text files vs binary files

Memory Basics

- Memory Hierarchy

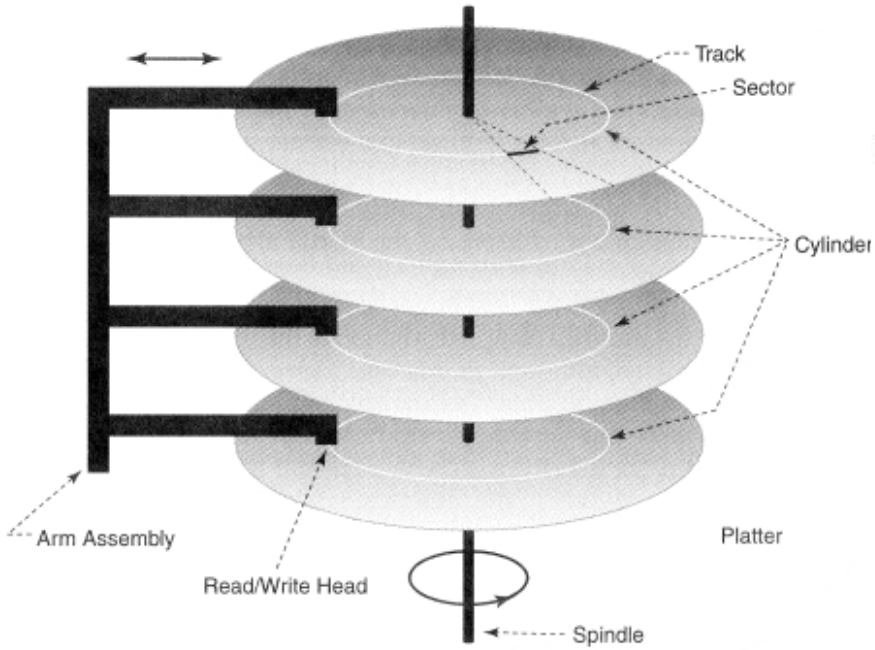


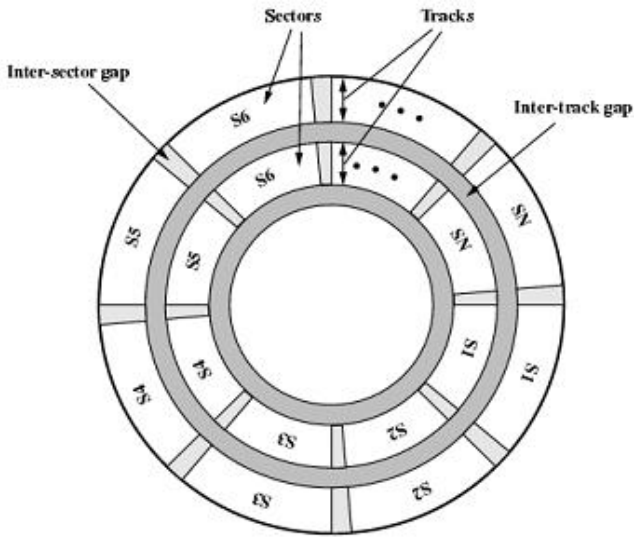
- Memory Access Modes
  - Linear
  - Random

Memory Basics: Disk I/O

- Operations (seek, read, write)

  e.g. Scenario of the booting process, opening file, saving file

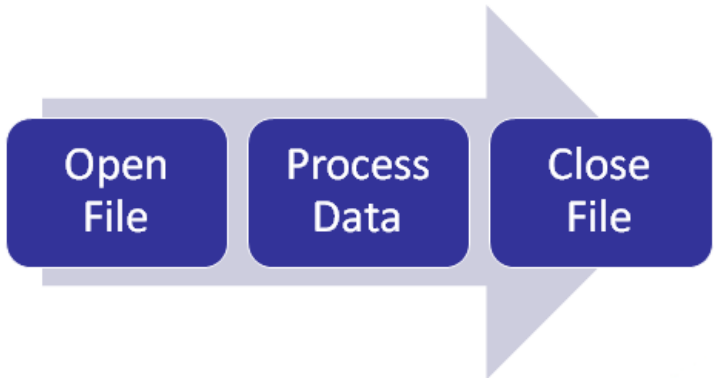




- Delays (seek time, rotational latency, data transfer)

File Operations (Python)

- The `file` object provides methods to manipulate files.
- Generic steps:



- Common Operations:
  1. Reading from a file
  2. Writing to a file

File Operations: 1. Opening

Syntax: `file_object = open(file_name, [access_mode])`

- `open()` returns an object of type *file* on a success, error otherwise.
- The returned `file_object` does not hold the file contents, rather a 'window' through which `file_name` can be viewed.

- Access modes:

Mode	**Operation**
r	open for read (default)
w	open for write
a	open for append
[rwa]+	open for read and write
[rwa]b	open for binary read, write & append respectively.
[rwa]b+	open for binary read and write
rU/U	open for read with universal Newline support.

File Operations: 2. Reading

- File be opened first for reading.
- Methods are accessed via a file object, say f.

Read Methods

```
f.read()          # read entire file & return as string
f.read(n)         # read n bytes
f.readline()      # read a line until '\n'
f.readlines()     # returns the file as a list
```

Example

```
>>>f = open('file1', 'r')
>>>type(f)
>>>f.read()
>>>f.close()
```

```
>>>f = open('file2')
>>>line = f.readline()
>>>print(line)
>>>f.close()
```

File Operations: 2. Reading

- File be opened first for reading.
- Methods are accessed via a file object, say f.

Read Methods

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f.read()          # read entire file & return as string
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Example

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>>>f = open('file1', 'r')
>>>type(f)
>>>f.read()
>>>f.close()
```

```
>>>f = open('file2')
>>>line = f.readline()
>>>print(line)
>>>f.close()
```

File Operations: 3. Writing

- File be opened first for writing/appending.

Write Methods

```
f.write(str)                    # write str unto the opened file
f.writelines(list)              # write strings in list as lines
```

Example

```
>>>f = open('somefile.txt', 'w')
>>>f.write('I love Bhutan \n')
>>>f.write('Long live his majesty! \n')
>>>f.close()

>>>open('somefile.txt').read()          # reading in one go
>>>print(open('somefile.txt').read() )    # Any difference?
```

File Operations: 3. Writing

- File be opened first for writing/appending.

Write Methods

```
f.write(str)                    # write str unto the opened file
f.writelines(list)              # write strings in list as lines
```

Example

```
>>>f = open('somefile.txt', 'w')
>>>f.write('I love Bhutan \n')
>>>f.write('Long live his majesty! \n')
>>>f.close()

>>>open('somefile.txt').read()          # reading in one go
>>>print(open('somefile.txt').read() )   # Any difference?
```

- Why close?
  - Open files consume resources
  - Shared access issues
- The Python garbage collector closes when reference count = 0.
- Good habit to close when done.
- The `close()` method frees the lock held by the file if any.

  Syntax: `file_object.close()`
- Any operation on a closed file?

Other Useful Methods

- `f.seek(offset, [from])`
  - Move to <offset> bytes starting from position <from> within the file f.
  - <from> = 0 for beginning of file, 1 for current location, 2 for EOF.
- `f.tell()`
  - The current location in the open file f.

Example

```
>>>f = open('MyFile.txt', 'w+')
>>>f.write('Ancient of Days')
>>>f.tell()
>>>f.seek(5,0)
>>>f.seek(10,1)
>>>f.tell()
>>>f.readline()  # begins from?
>>>f.close()
```

File Attributes

- Hold auxiliary data related to the file object, f.
  - `f.name`
  - `f.mode`
  - `f.closed`

Example

```
>>>fo = open('MyFile.txt', 'r')
>>>print("Name: ", fo.name)
>>>print("Mode: ", fo.mode)
>>>print("File closed, right? ", fo.closed)
```

Working with System Files

- The sys module provides system-specific info related to your Python interpretter.

Example

```
dir(sys)

sys.platform          # where is it installed?

sys.version           # of Python interpretter

sys.prefix            # the directory prefix

sys.argv              # list of command-line args

sys.path              # search path for modules
```

- The os module provides methods to use OS-dependent functionalities.

1. Directory and File Manipulation

Example

```
# directory operations

x = os.getcwd()

os.listdir(x)

os.mkdir('somedir')

os.rename('old', 'new')

os.rmdir('somedir')
```

```
# file operations

f = open('test.txt')

f.close()

os.remove('test.txt')

etc...
```

2. Executing System Commands (os.system)

Example

```
os.system('ls *')
os.system('cp source dest')                    etc...
```

3. Path Manipulation (os.path)

Example

```
p = os.path.abspath('test.txt')

os.path.split(p)

os.path.dirname(p)

os.path.basename(p)

os.path.join('path1', 'path2', 'path3')          etc...
```

Exercise!

1. Total number of lines in a file. How about the first N lines?
2. Shortest/Longest line of a file.
3. Copy file contents to another file.
4. Given a file named `marks.txt` with the following data:

```
Pema    30    20    30
Chimi   15    24    37
Dorji   35    19    35
```

Write a program that reads the marks from the file, computes the total mark for each person and writes to a file named `TotalMarks.txt`.