[220 / 319] Files

Department of Computer Sciences
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Readings:
Chapter 14 of Downey book

Learning Objectives Today

Basic file interactions

- opening/closing
- reading/writing

OS module

- listdir, mkdir, exists, isdir, isfile, join

File exceptions

Encodings

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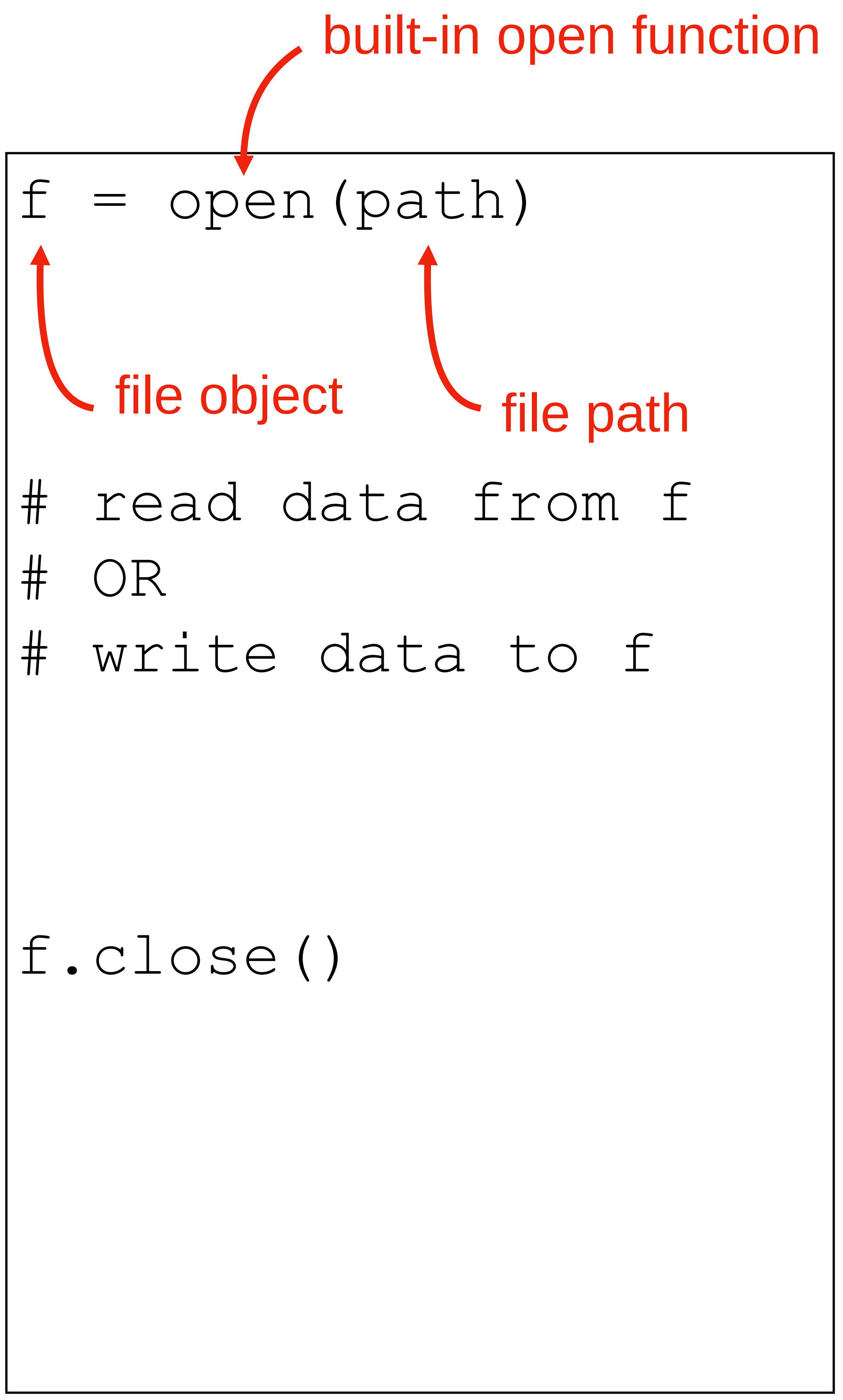
File objects



```
f = open(path)


# read data from f
# OR
# write data to f



f.close()
```

File objects

built-in open function

main.ipynb:

```
f = open(path)
```

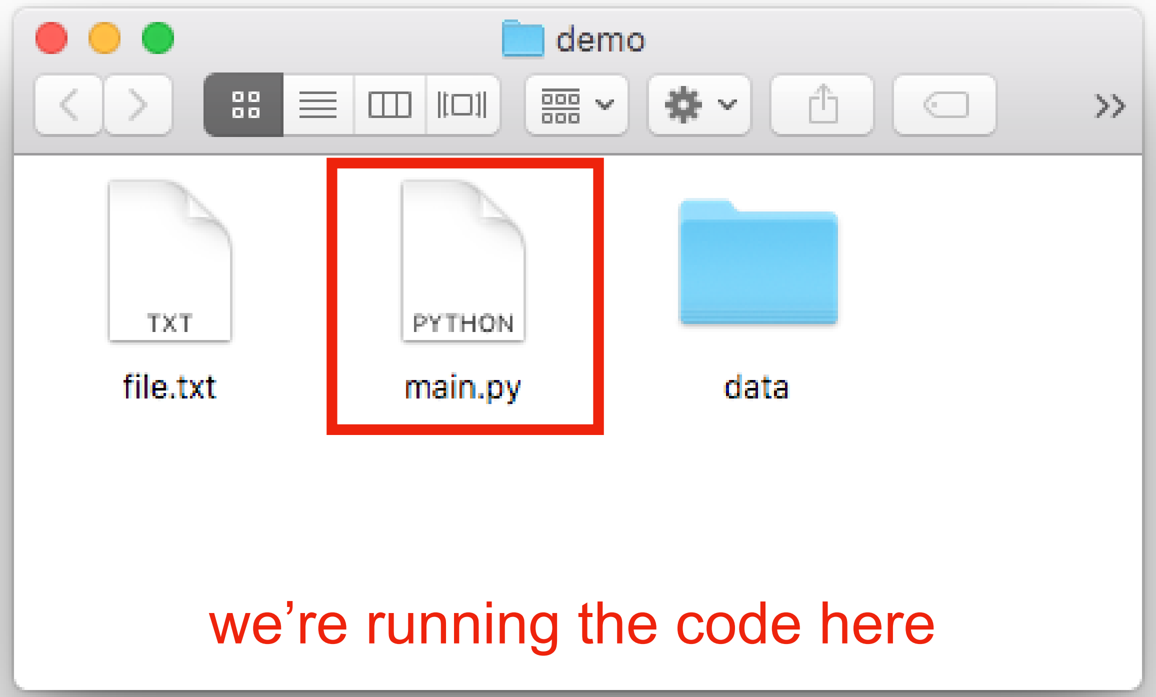
file object

file path

```
# read data from f
# OR
# write data to f



f.close()
```



we're running the code here

File objects

built-in open function

main.ipynb:

```
f = open("file.txt")
```

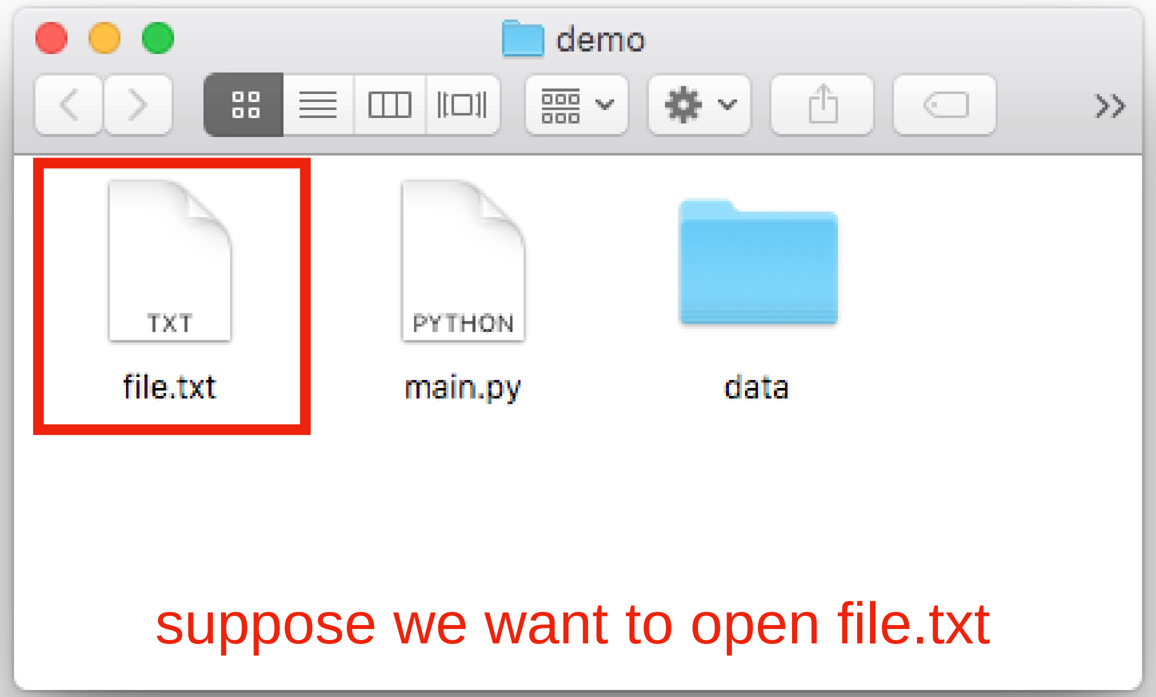
file object

file path

```
# read data from f
# OR
# write data to f



f.close()
```



suppose we want to open file.txt

File objects

built-in open function

main.ipynb:

```
f = open(
   "data/movies.csv")
```

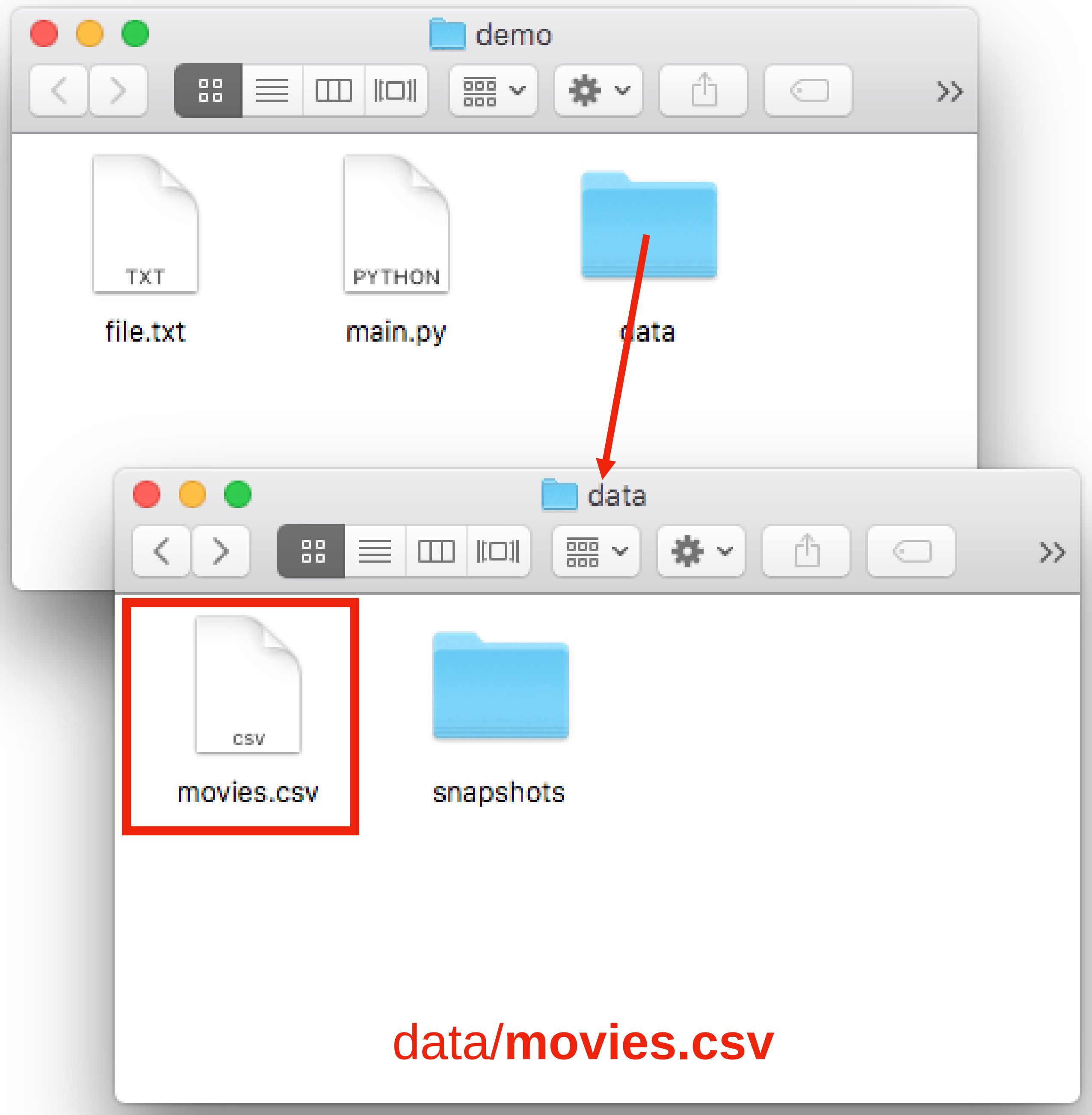
file object

file path

```
# read data from f
# OR
# write data to f



f.close()
```



data/**movies.csv**

File objects

built-in open function

main.ipynb:

```
f = open(
    "data/snapshots/A")
```

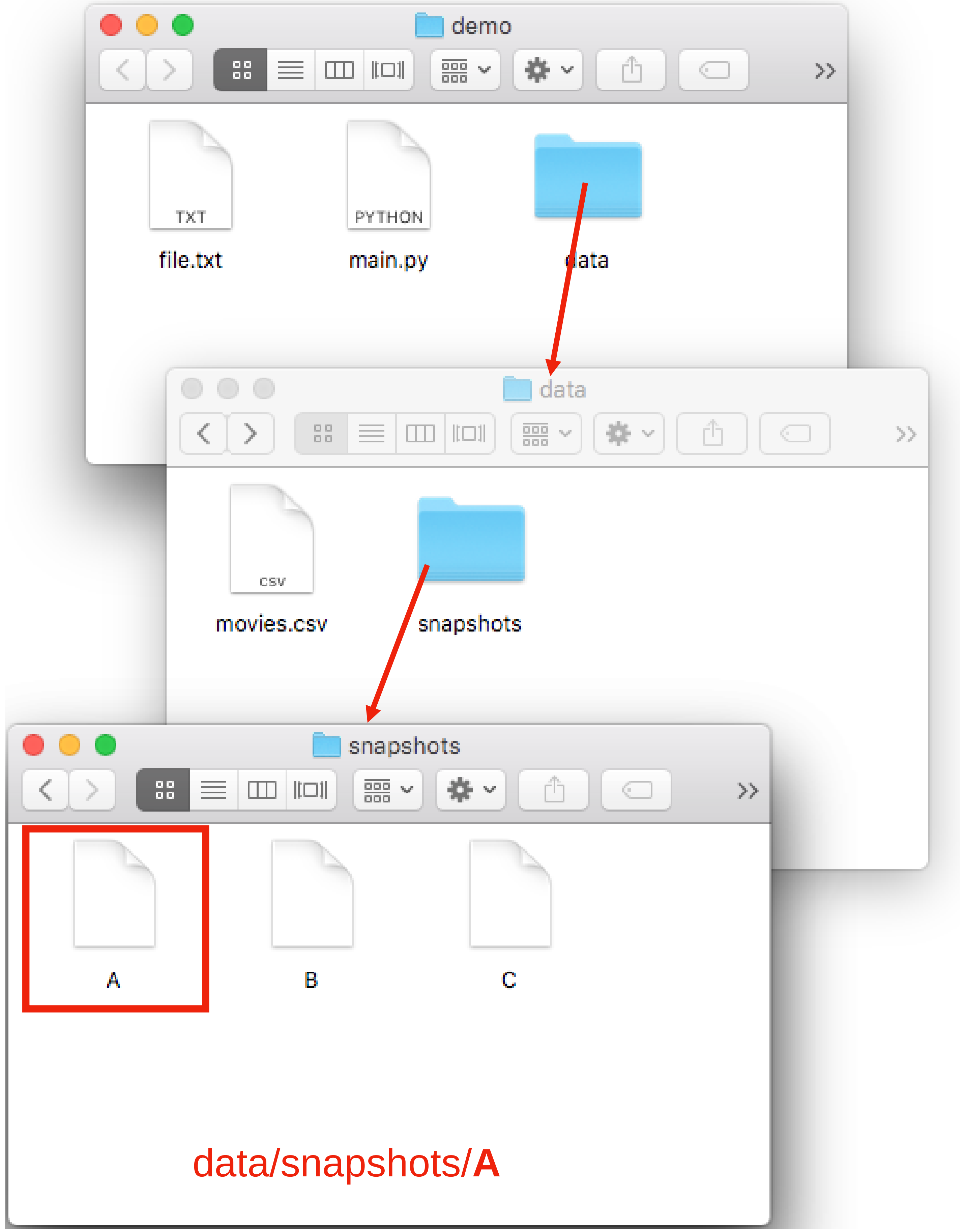
file object

file path

```
# read data from f
# OR
# write data to f



f.close()
```



File objects

main.ipynb:

```
f = open("file.txt")



# read data from f
# OR
# write data to f



f.close()
```

File objects

main.ipynb:

```
f = open("file.txt")



# read data from f
# OR
# write data to f

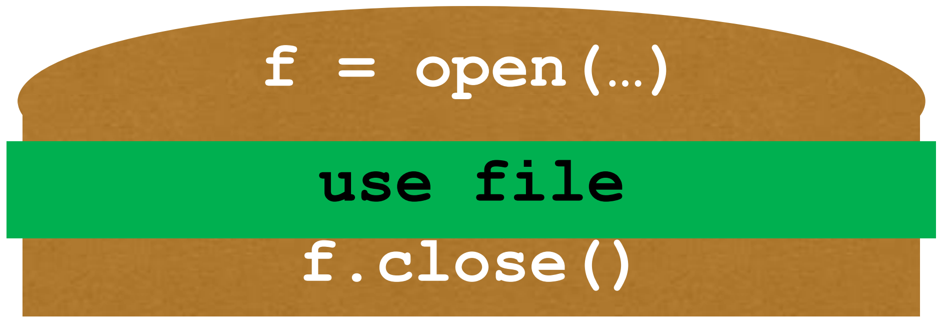


f.close()
```

using file

File objects

imagine a file object as a sandwich…



main.ipynb:

```
f = open("file.txt")



# read data from f
# OR
# write data to f



f.close()
```

using file

cleanup

Reasons for closing

- avoid data loss
- limited number of open files

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Reading a file

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# read data from f
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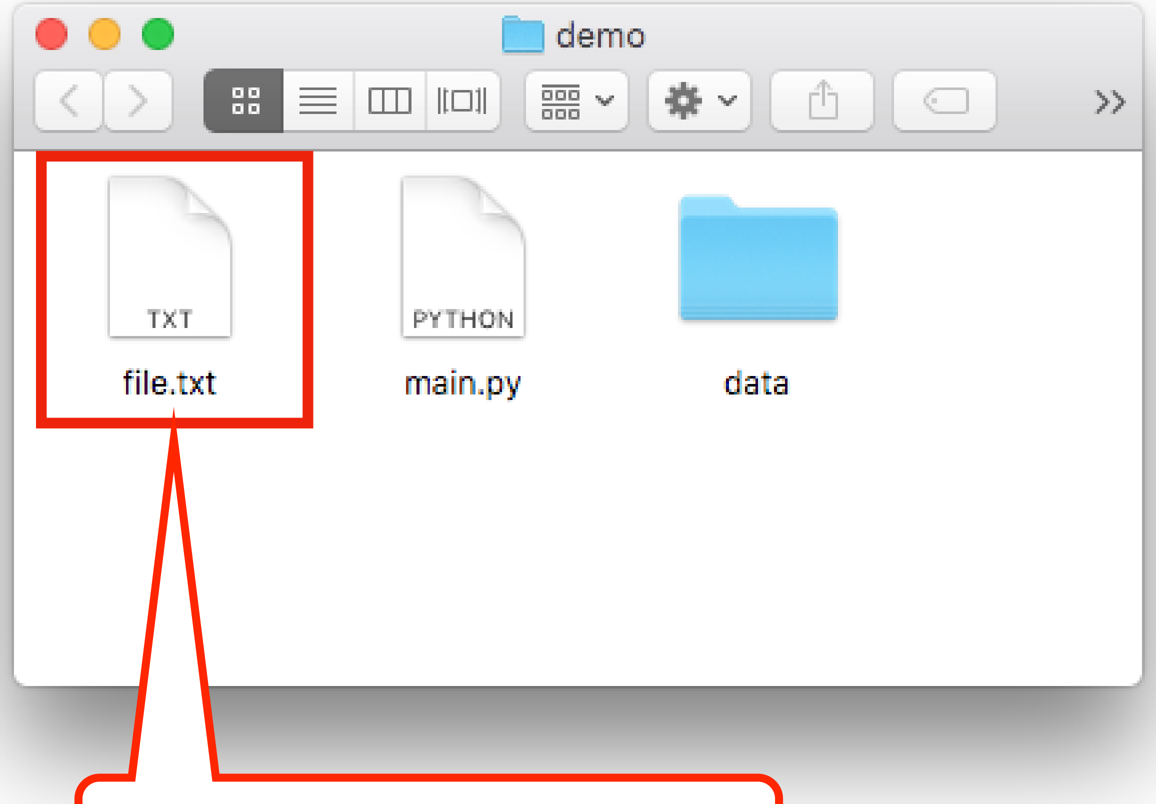
f.close()
```



I promise
to always
close my files

Reading a file

```
f = open("file.txt")



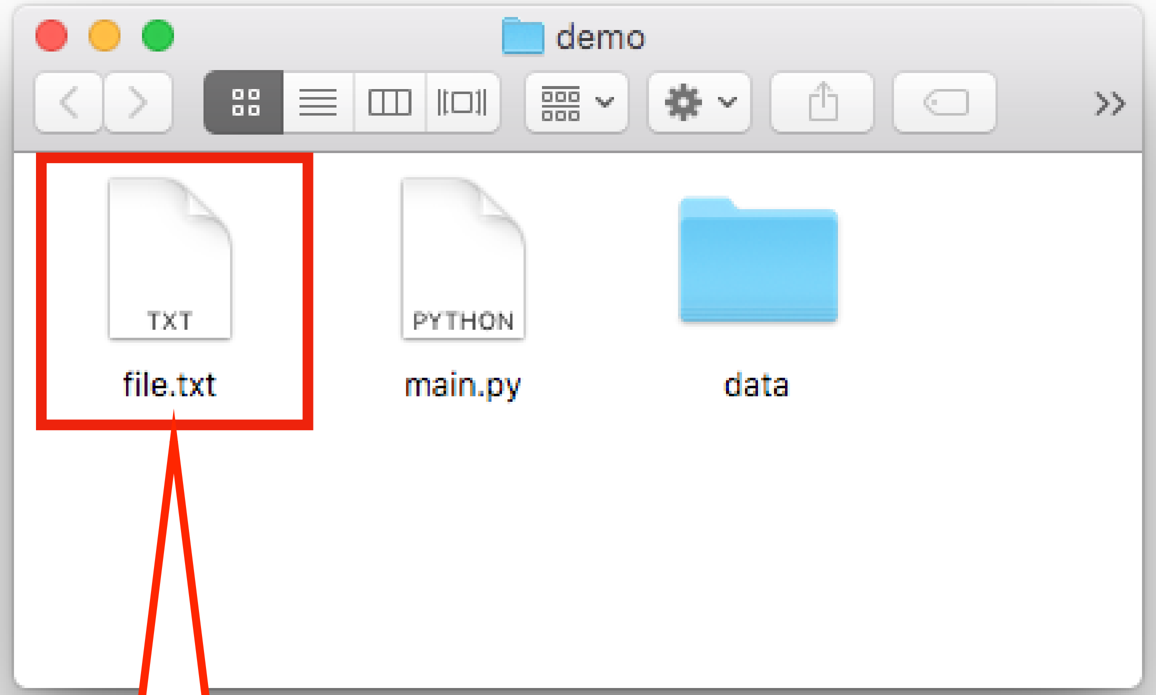
data = f.read()

print(data)


f.close()
```

Option 1

data is: "I promise\nto always\nclose my files"



I promise
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`read()` method

- fetch entire file contents
- return as a string

Reading a file

```
f = open("file.txt")



# read data from f
# OR
# write data to f



f.close()
```

Option 2

file objects can be iterated over, using a for loop!

Reading a file – alternate ways

```
f = open("file.txt")
lines = list(f)
f.close()
```

convert it to a list

```
f = open("file.txt")
for l in f:
    print(l)
f.close()
```

iterate over f with a for loop

Write a file

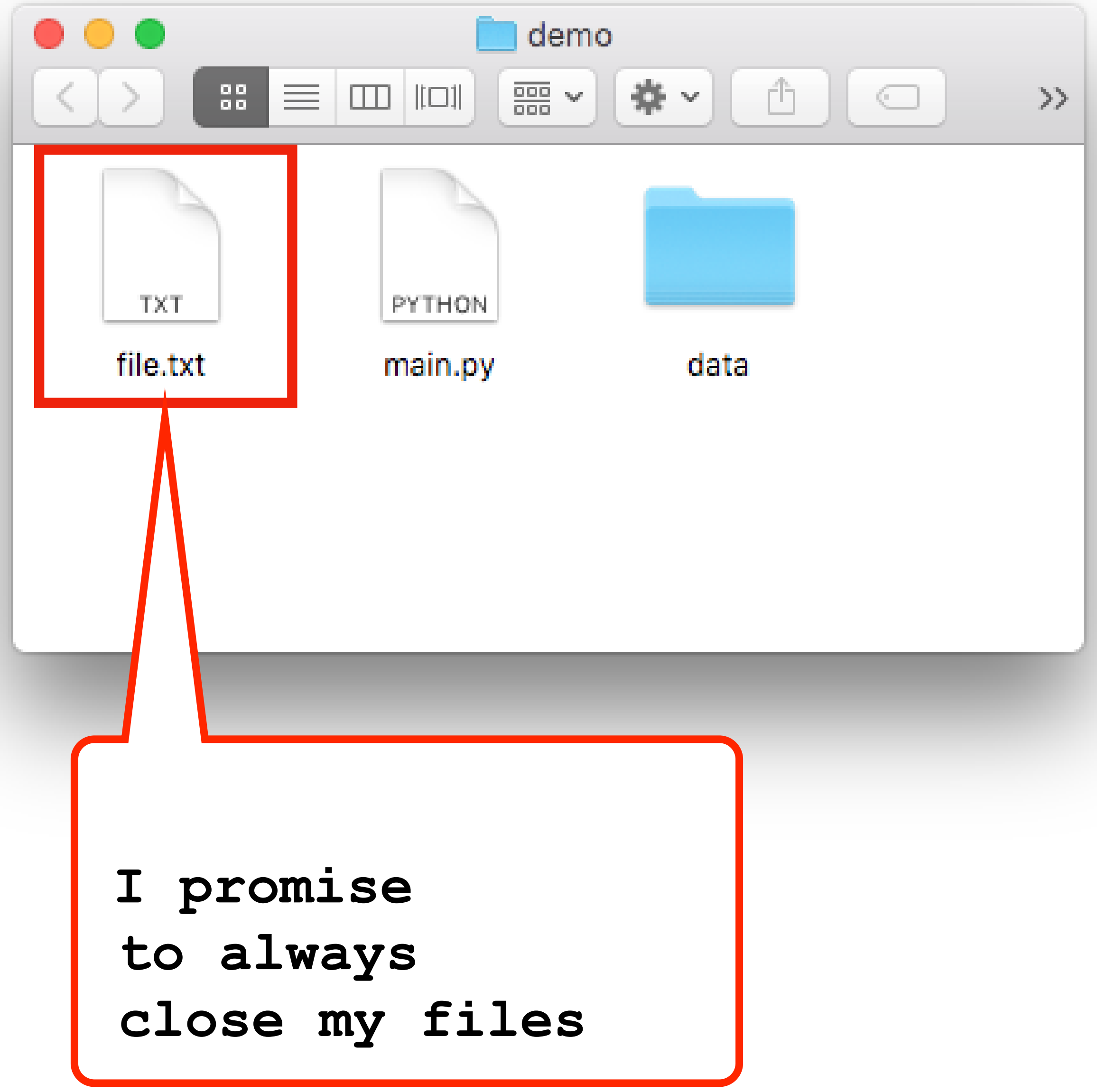
```
f = open("file.txt")



# read data from f
# OR
# write data to f



f.close()
```



I promise
to always
close my files

Write a file

"w" mode indicates we want to write to this file

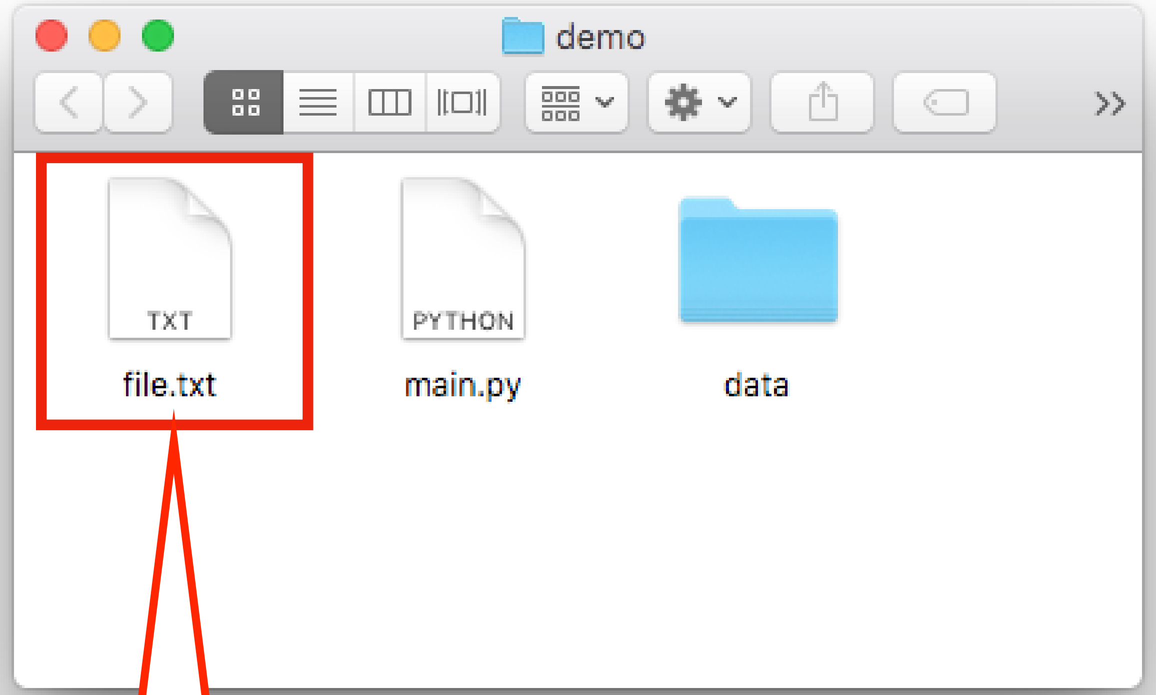
```
f = open("file.txt", "w")



# read data from f
# OR
# write data to f



f.close()
```



I promise to always close my files

Write a file

“w” mode indicates we want to write to this file

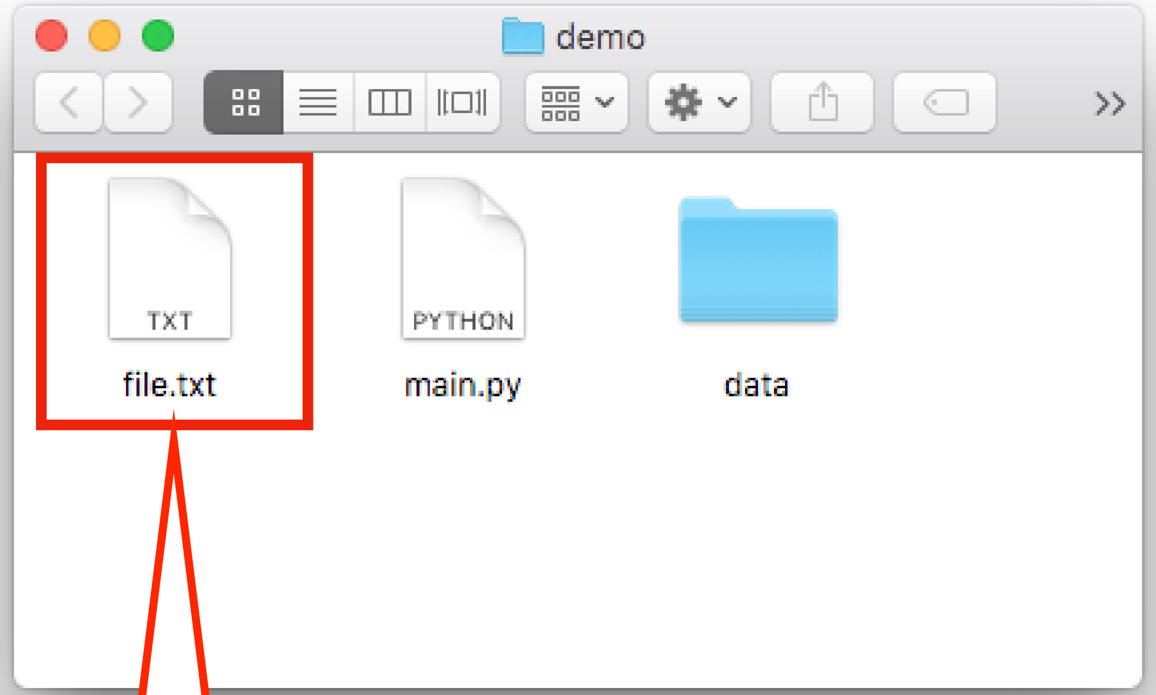
```
f = open(“file.txt”, “w”)



f.write(“hello”)
f.write(“ world\n”)
f.write(“!!!!!\n”)



f.close()
```



I promise
to always
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let’s run it!

Write a file

“w” mode indicates we want to write to this file

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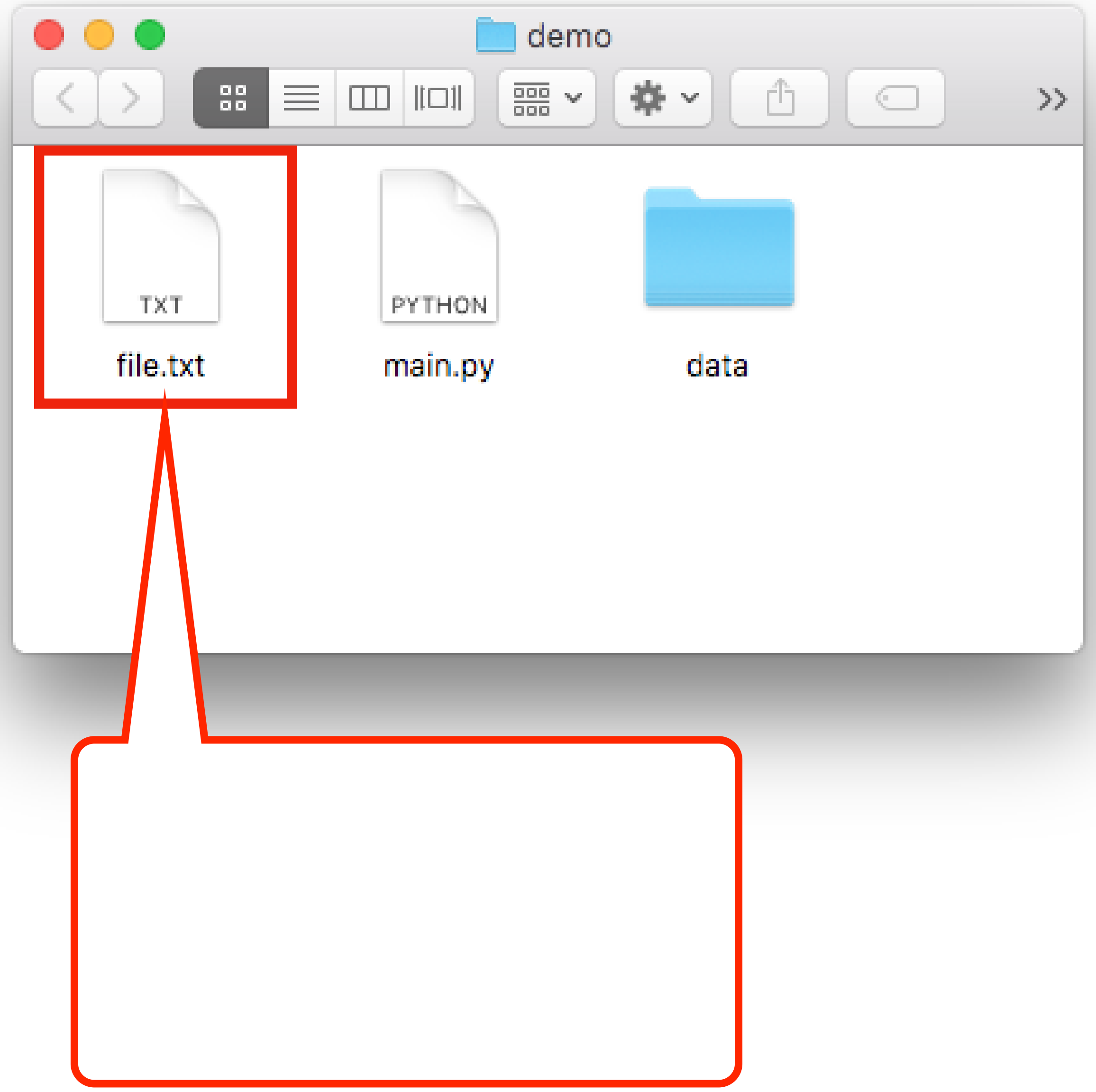

opening with “w” is dangerous. It immediately wipes out your file.

(or creates a new one if there isn’t already a file.txt)

Write a file

"w" mode indicates we want to write to this file

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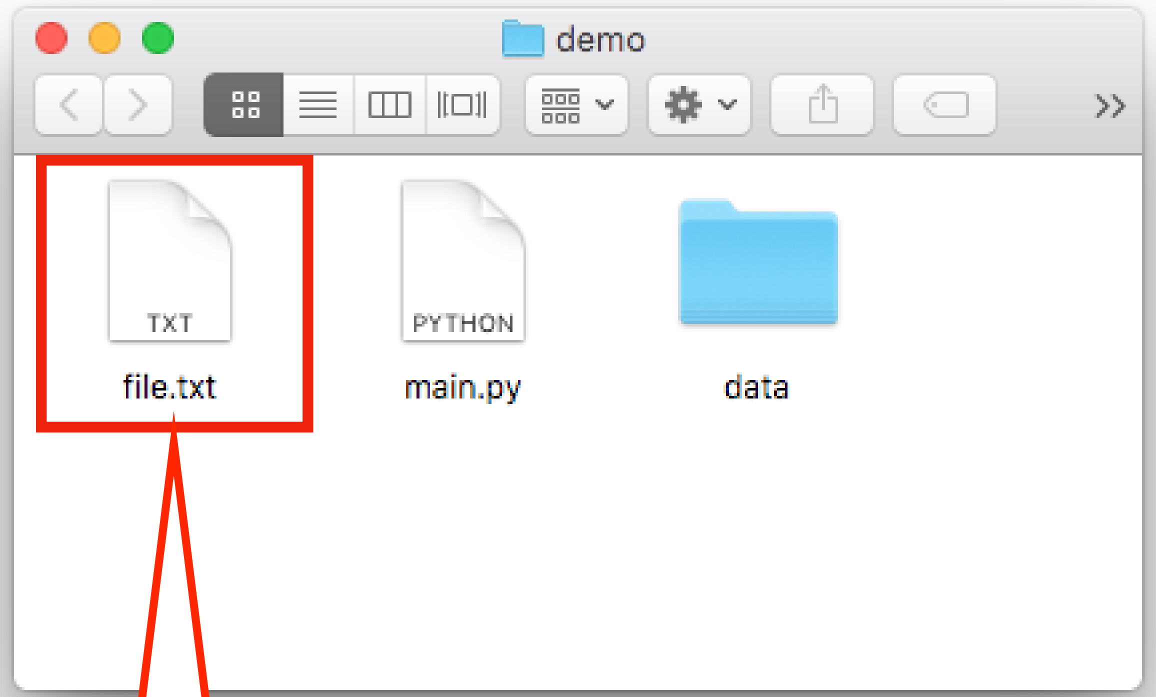

```
hello
```

Write a file

"w" mode indicates we want to write to this file

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f = open("file.txt", "w")



f.write("hello")
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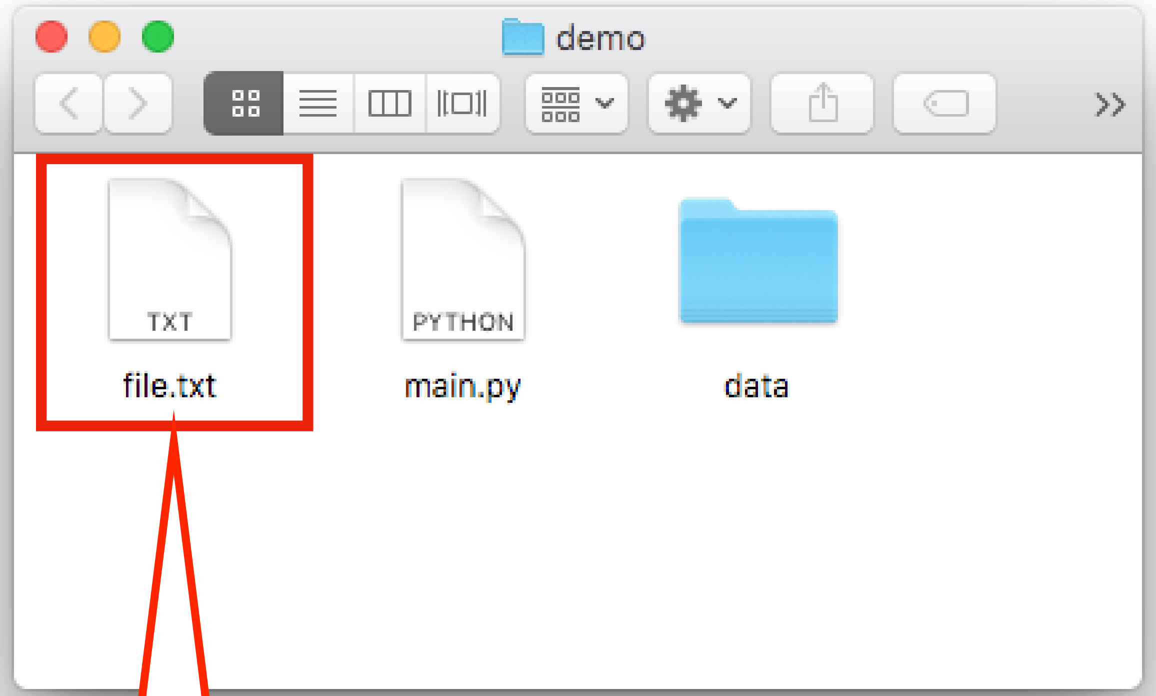


```
hello world
```

Write a file

“w” mode indicates we want to write to this file

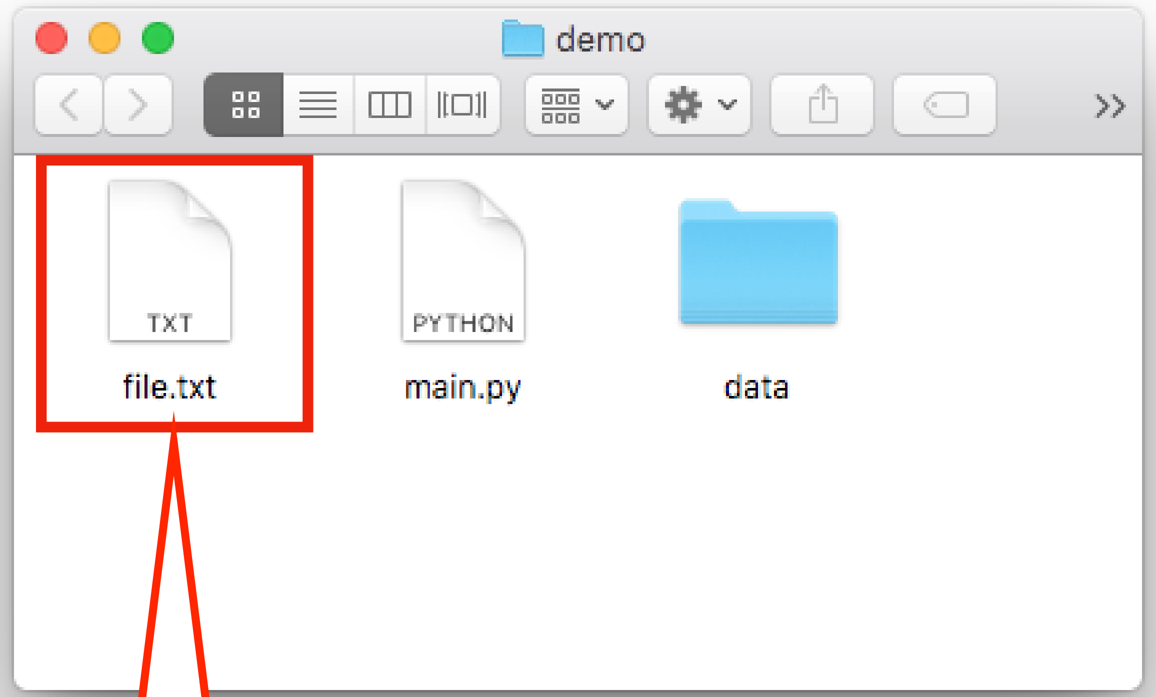
```
f = open(“file.txt”, “w”)



f.write(“hello”)
f.write(“ world\n”)
f.write(“!!!!!!\n”)



f.close()
```



```
hello world
!!!!!!
```

Write a file

"w" mode indicates we want to write to this file

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f = open("file.txt", "w")



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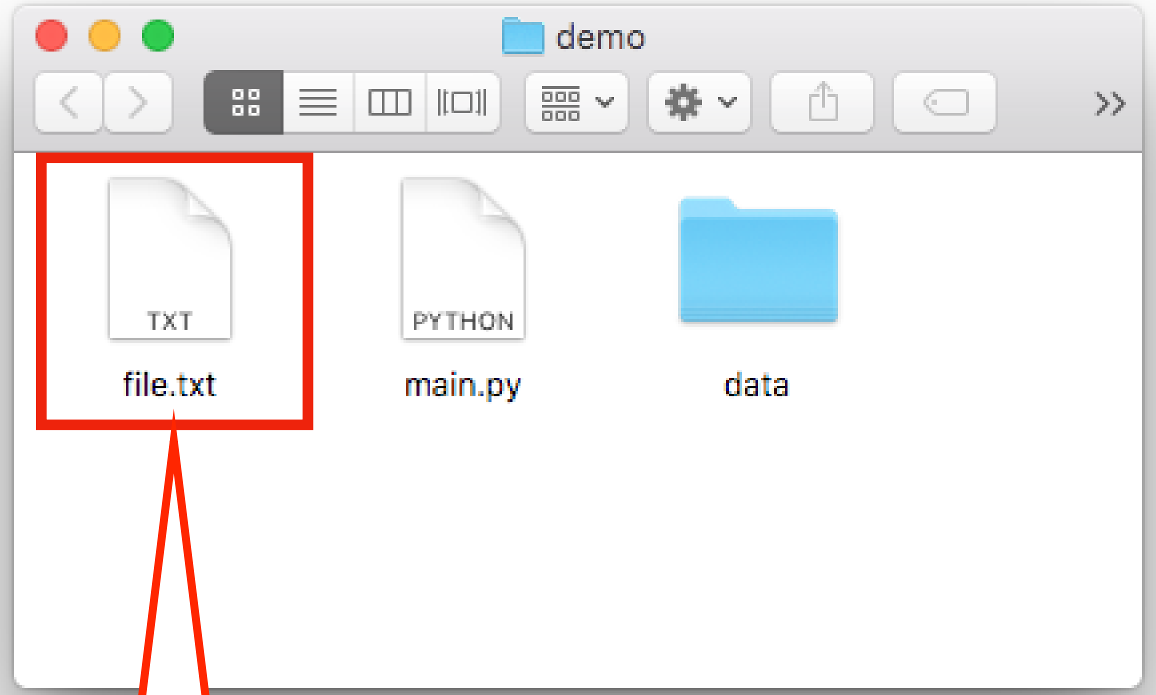
```



```
hello world
!!!!!
```

be careful with newlines
(write doesn't add them like print does)

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Encodings

OS Module (Operating System)

Many functions in os and os.path for working w/ files

- os.listdir
- os.mkdir
- os.path.exists
- os.path.isfile
- os.path.isdir
- os.path.join

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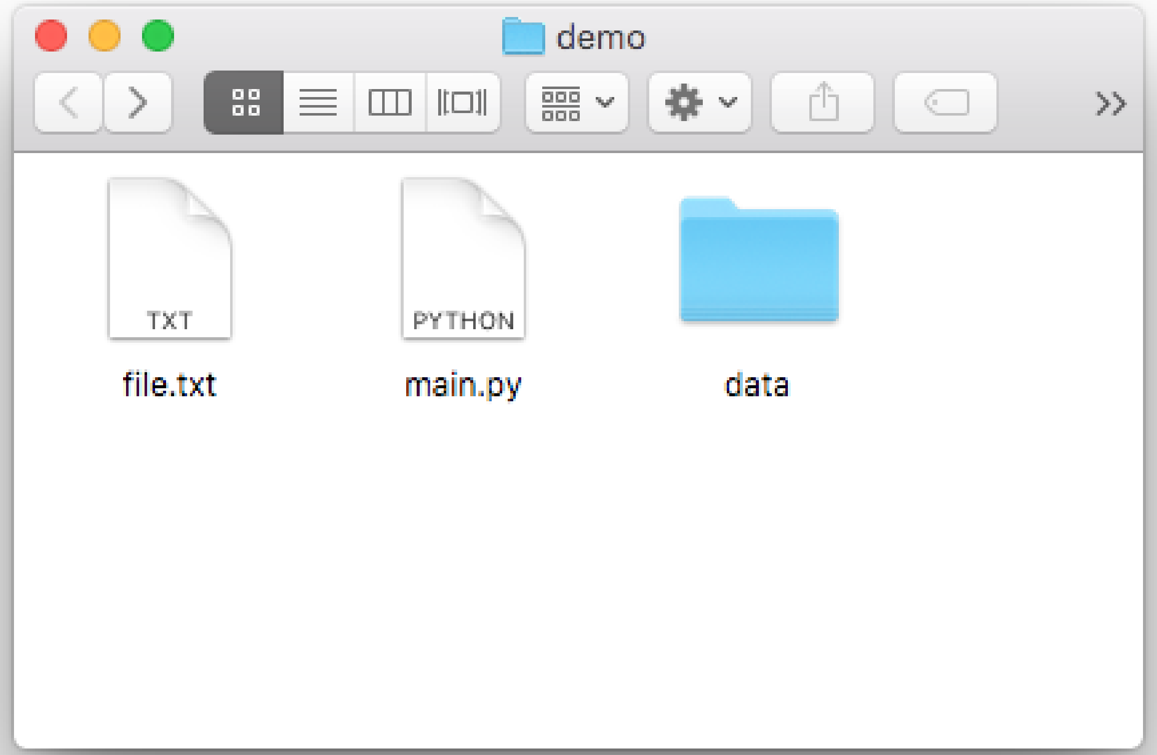
- os.path.isfile
- os.path.isdir
- os.path.join

```
>>> import os
>>> os.listdir(“.”)
[“file.txt”, “main.ipynb”, “data”]
```



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- os.listdir
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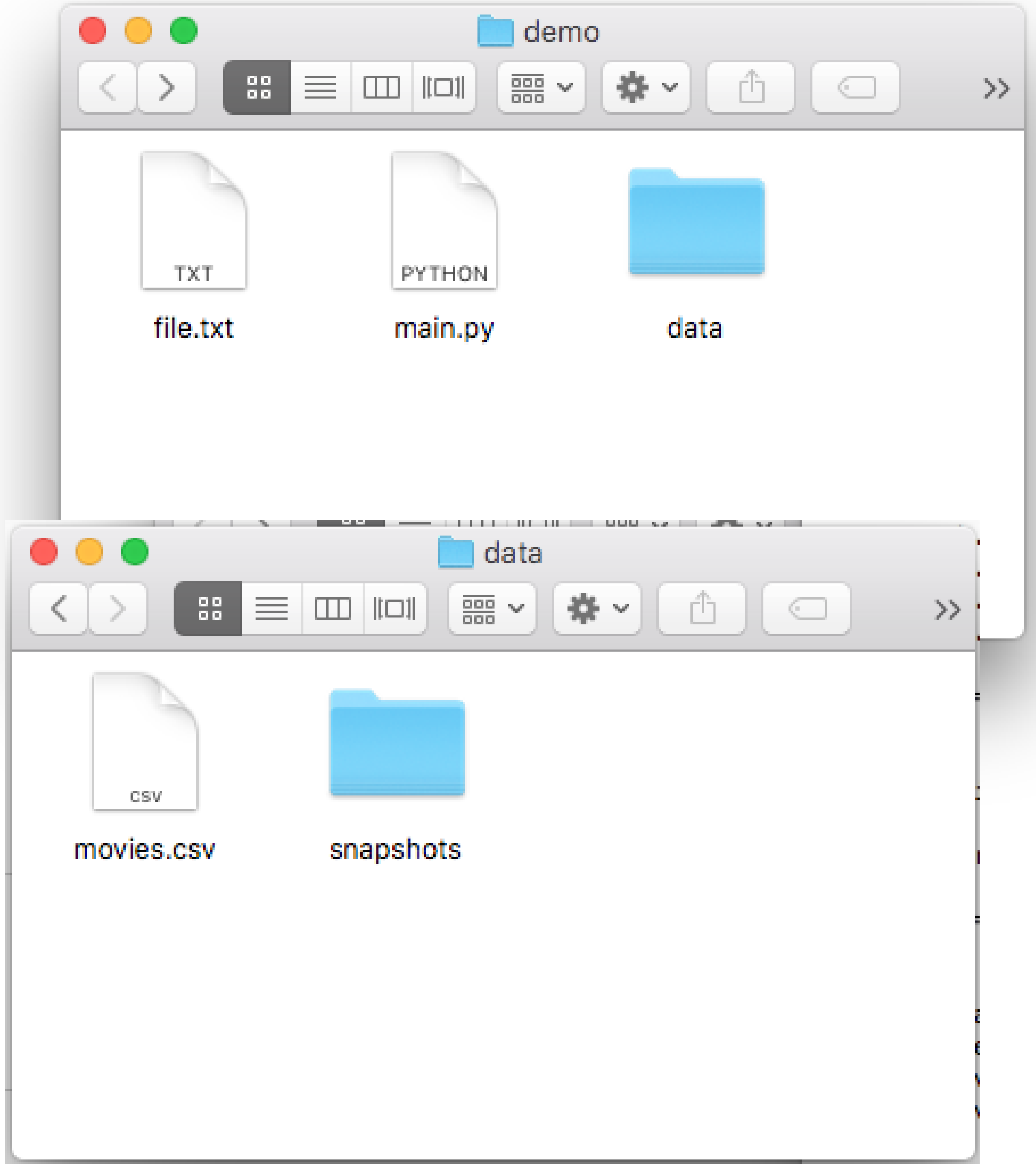
```
>>> import os
>>> os.listdir("data")
["movies.csv", "snapshots"]
```



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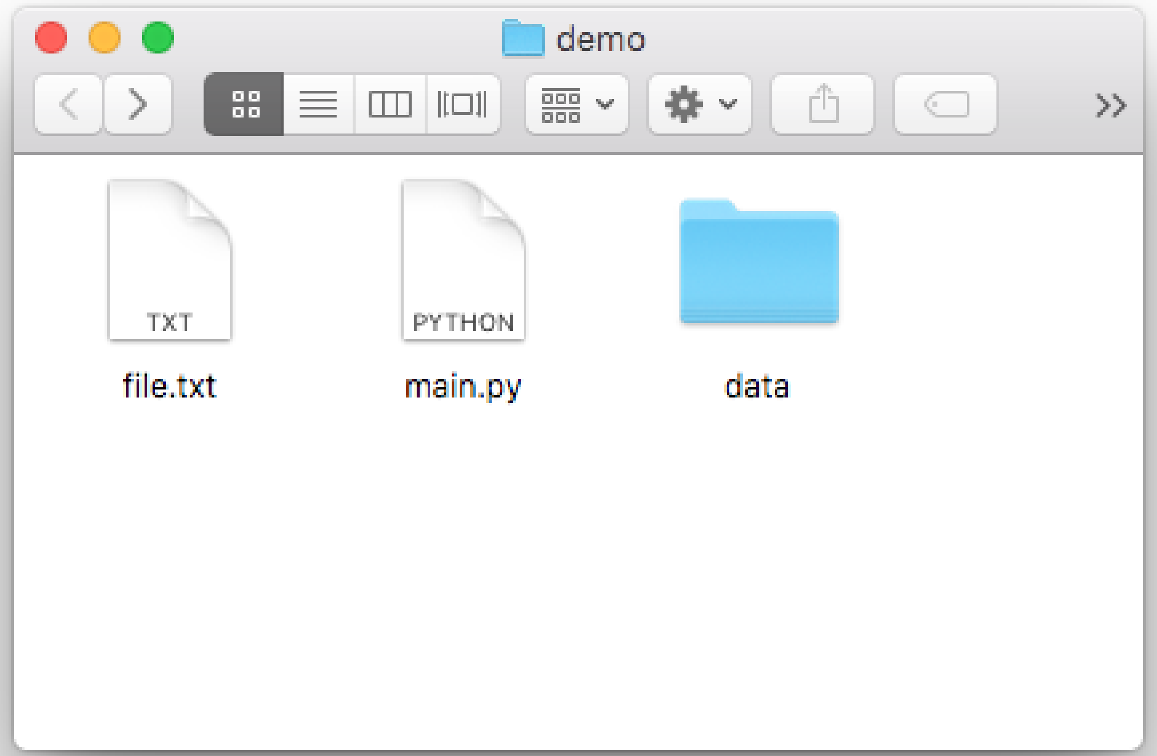
- os.path.join

```
>>> import os
>>> os.mkdir("test")
```



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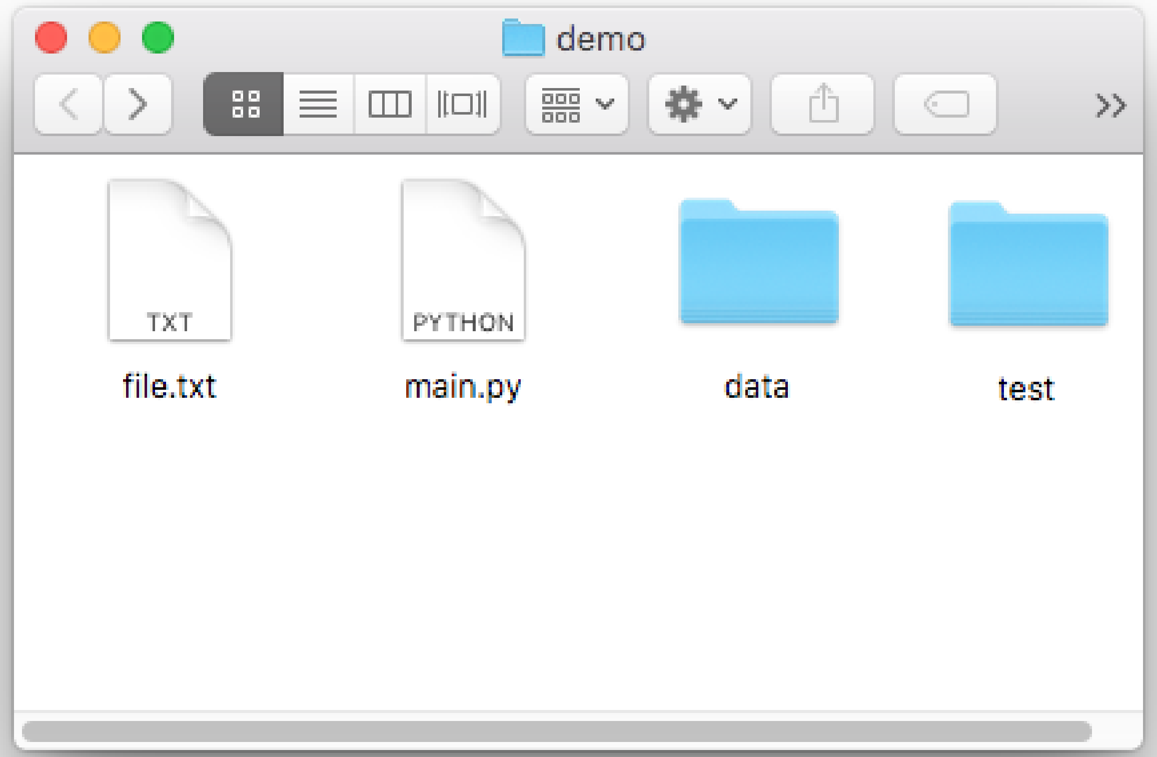
>>> os.mkdir("test")
```



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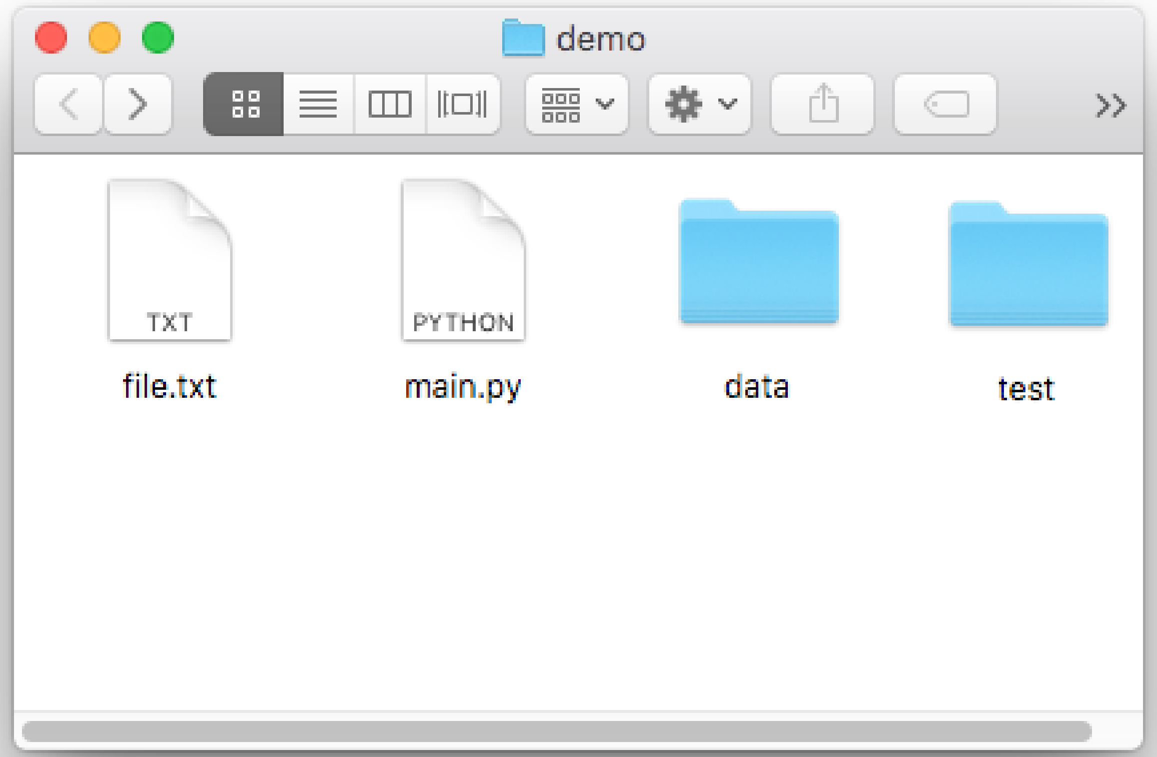
- os.listdir
- os.mkdir
- **os.path.exists**
- os.path.isfile
- os.path.isdir
- os.path.join

```
>>> import os
>>> os.path.exists("file.txt")
True
```



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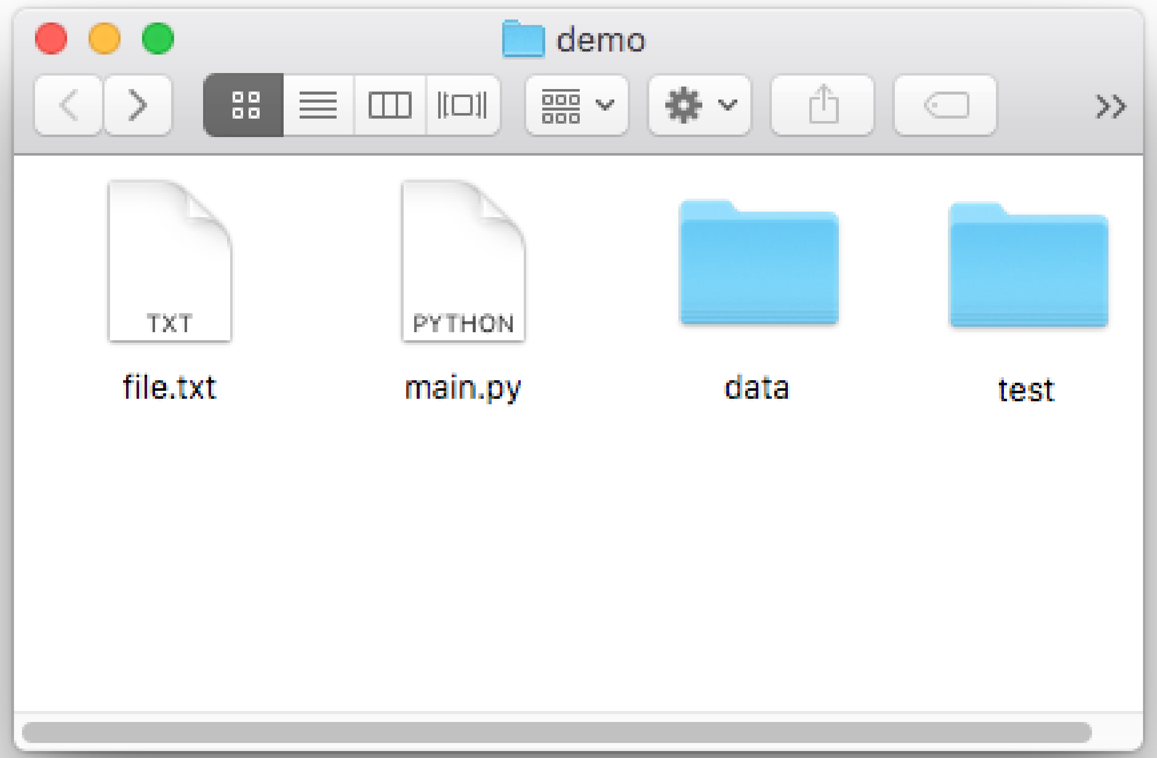
- os.path.join

```
>>> import os
>>> os.path.exists("haha.txt")
False
```



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- os.listdir
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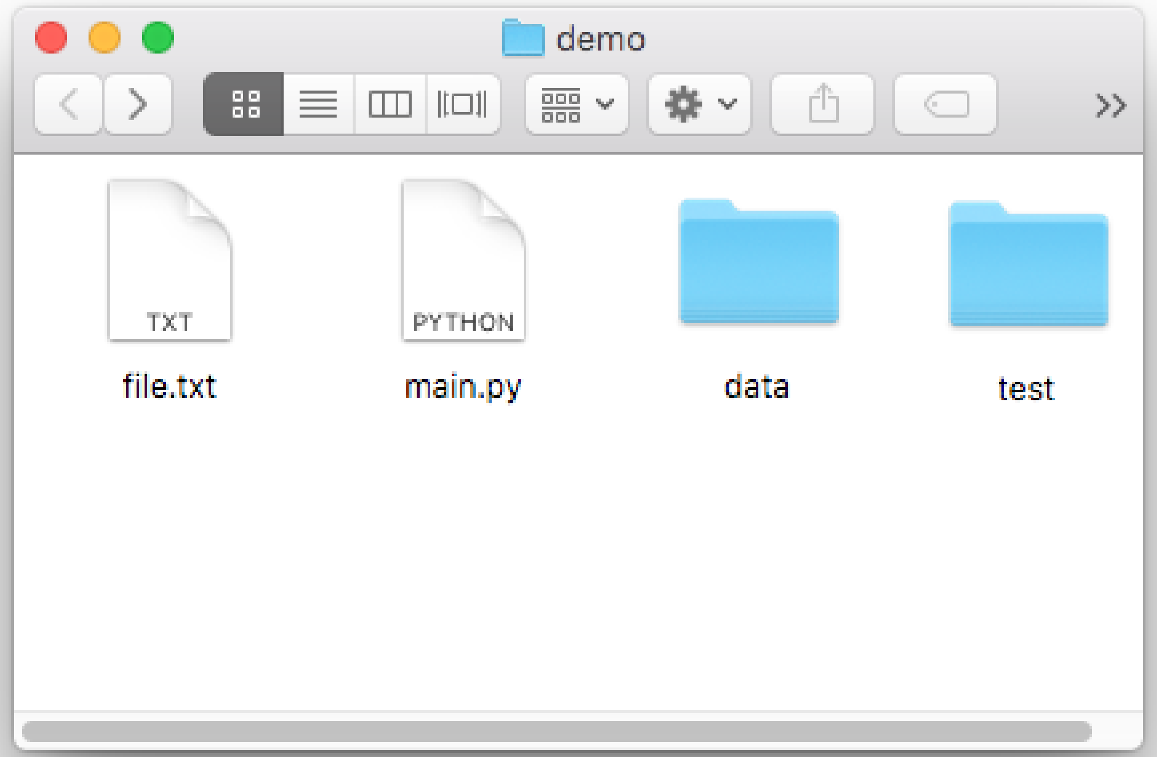
```
>>> import os
>>> os.path.isfile(“haha.txt”)
False
```



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- **os.path.isfile**
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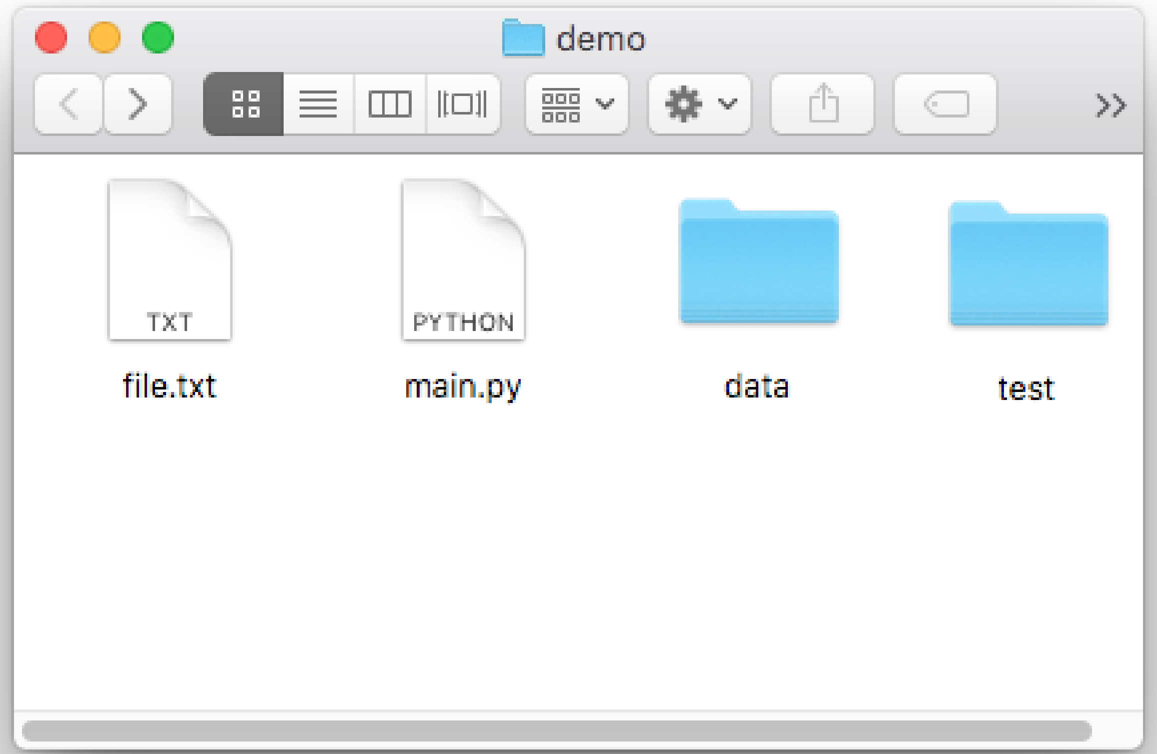
- os.path.join

```
>>> import os
>>> os.path.isfile("file.txt")
True
```



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- os.path.exists
- **os.path.isfile**
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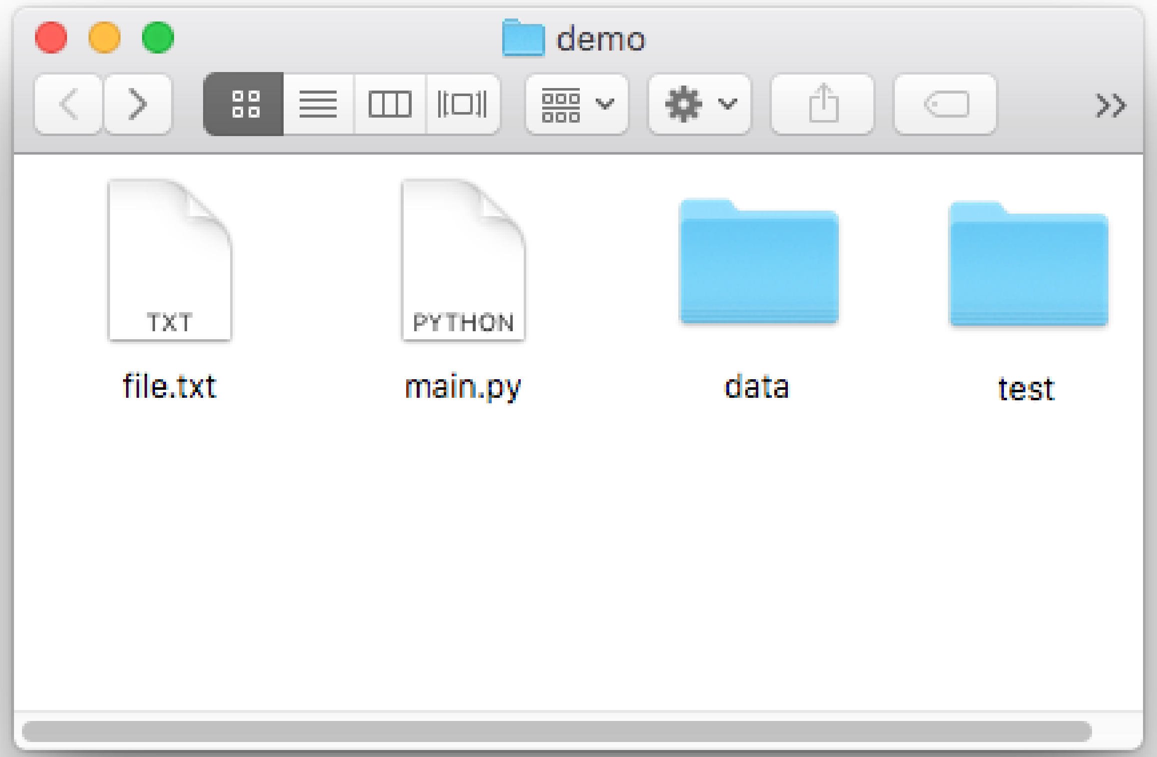
- os.path.join

```
>>> import os
>>> os.path.isfile("data")
False
```



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Many functions in os and os.path for working w/ files

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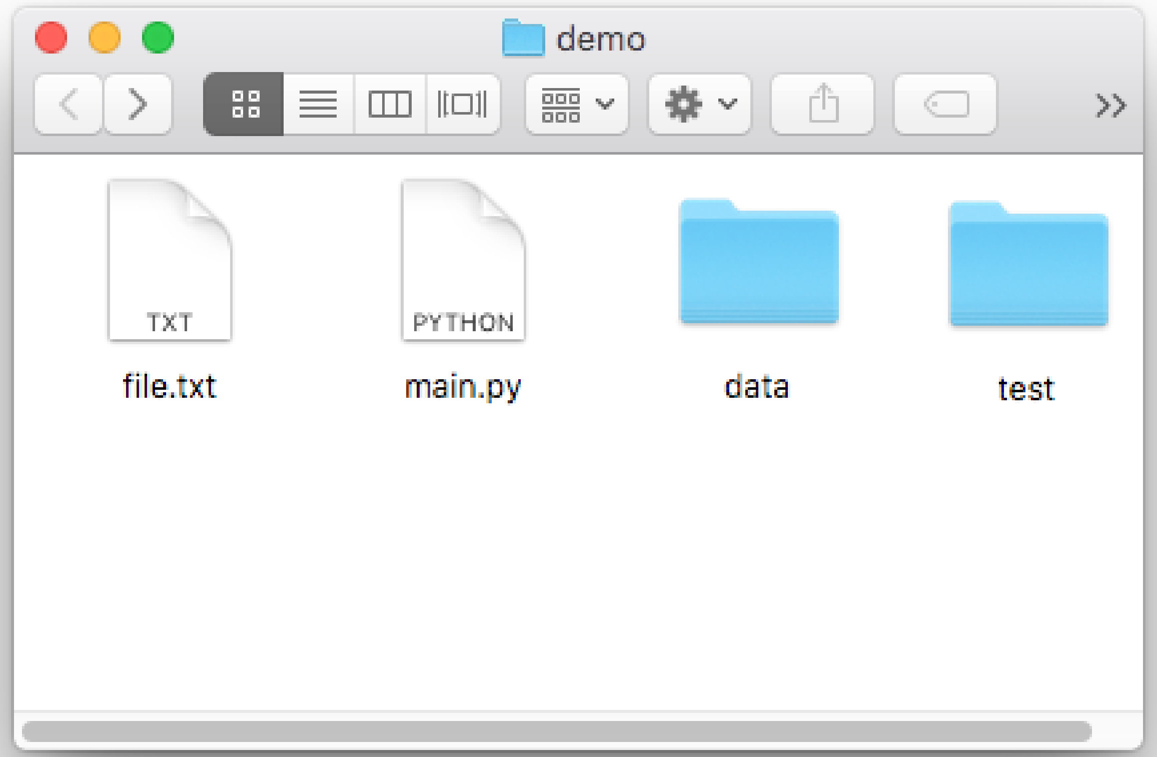
- os.mkdir
- os.path.exists
- os.path.isfile
- **os.path.isdir**
- os.path.join

```
>>> import os
>>> os.path.isdir("data")
True
```



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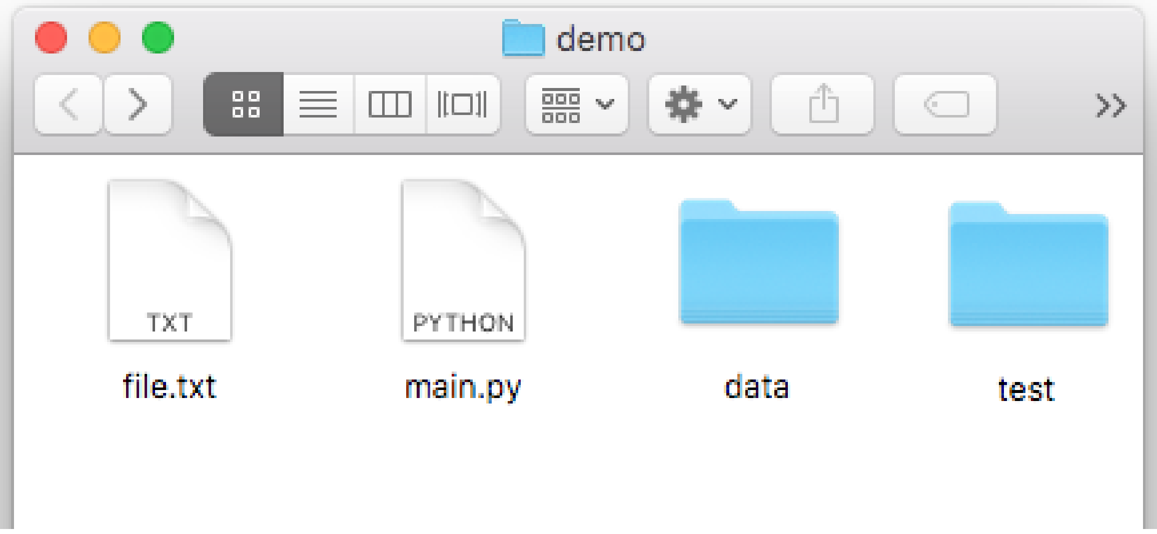

```
>>> import os
>>> os.path.join("data", "movies.csv")
data/movies.csv
```

on Mac/Linux

OS Module (Operating System)

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- os.path.exists
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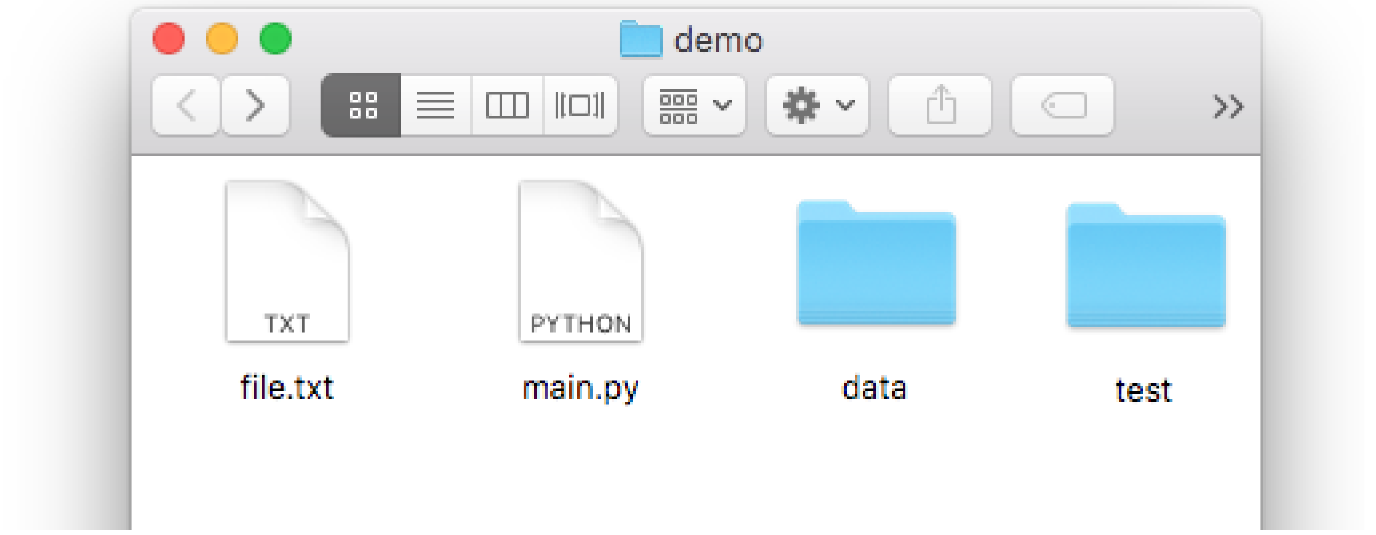
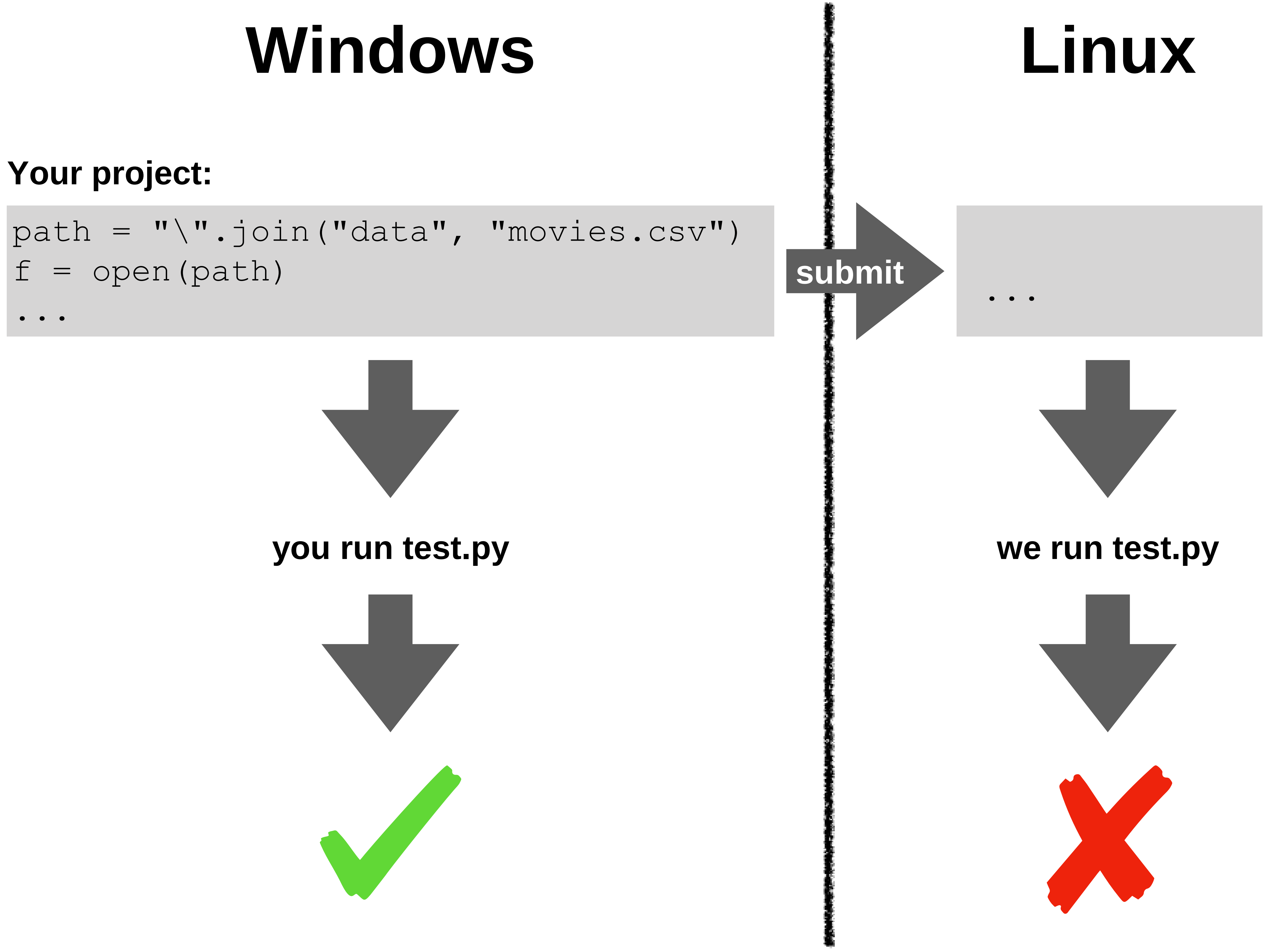


```
>>> import os
>>> os.path.join("data", "movies.csv")
data\movies.csv
```

↑

on Windows



```
path = "\".join("data", "movies.csv")
f = open(path)
...
```

```
...
```

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Exceptions

Working with files leads to many exceptions

- missing files
- lacking permissions
- not enough space
- mixing up directories and files
- corrupt formats
- etc, etc

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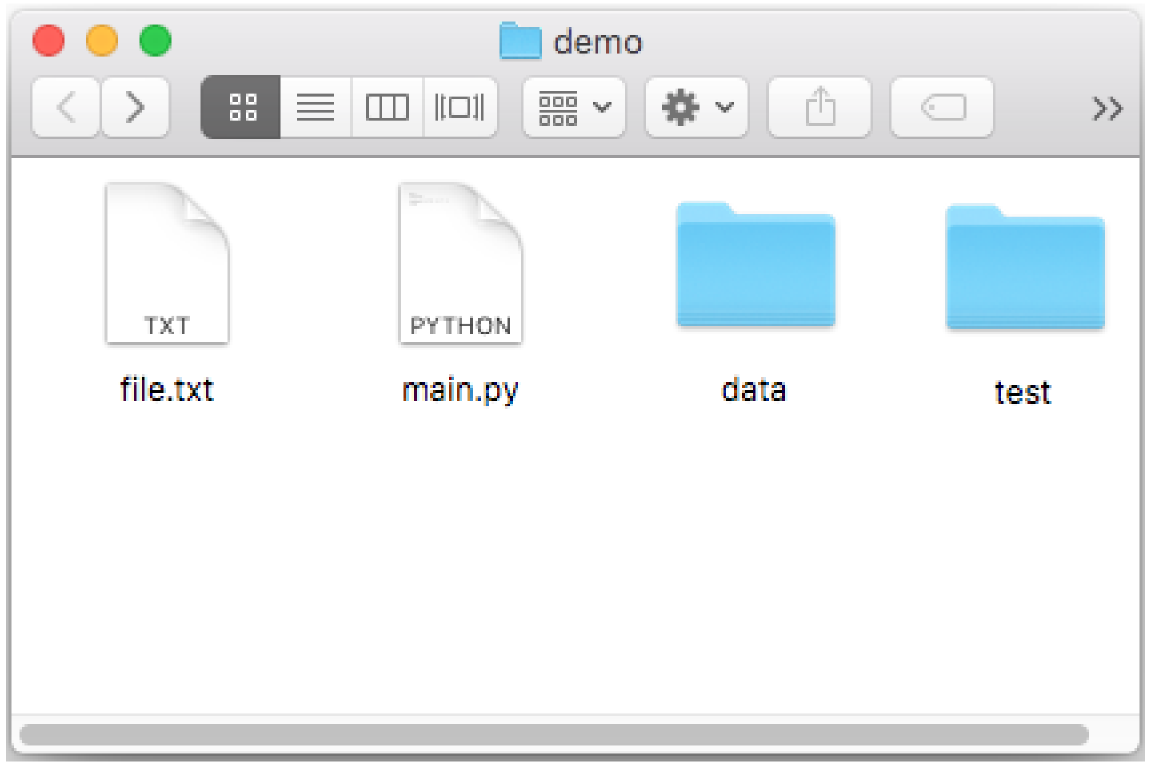


```
import os

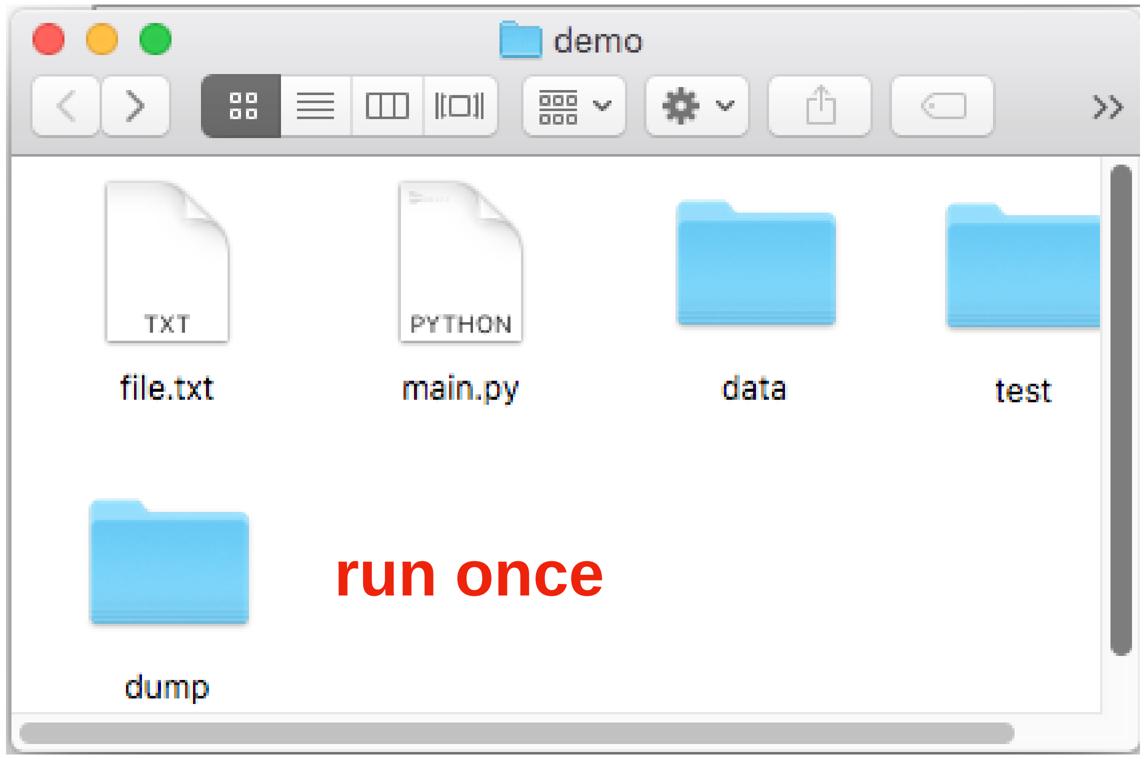
os.mkdir('dump')

f = open(os.path.join('dump', 'out.txt'), 'w')
f.write('hi')
f.close()
```

Exceptions

Working with files leads to many exceptions

- missing files
- lacking permissions
- not enough space
- mixing up directories and files
- corrupt formats
- etc, etc



run once

```
import os

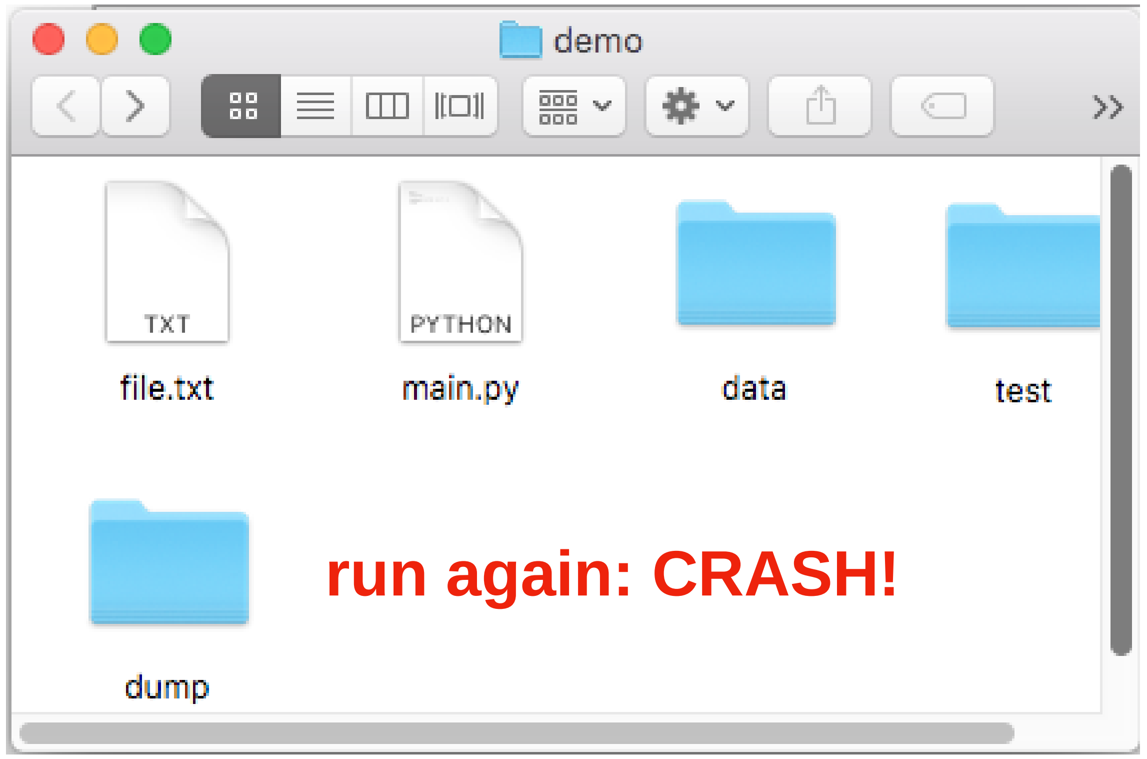
os.mkdir('dump')

f = open(os.path.join('dump', 'out.txt'), 'w')
f.write('hi')
f.close()
```

Exceptions

Working with files leads to many exceptions

- missing files
- lacking permissions
- not enough space
- mixing up directories and files
- corrupt formats
- etc, etc



run again: CRASH!

```
import os

os.mkdir('dump')

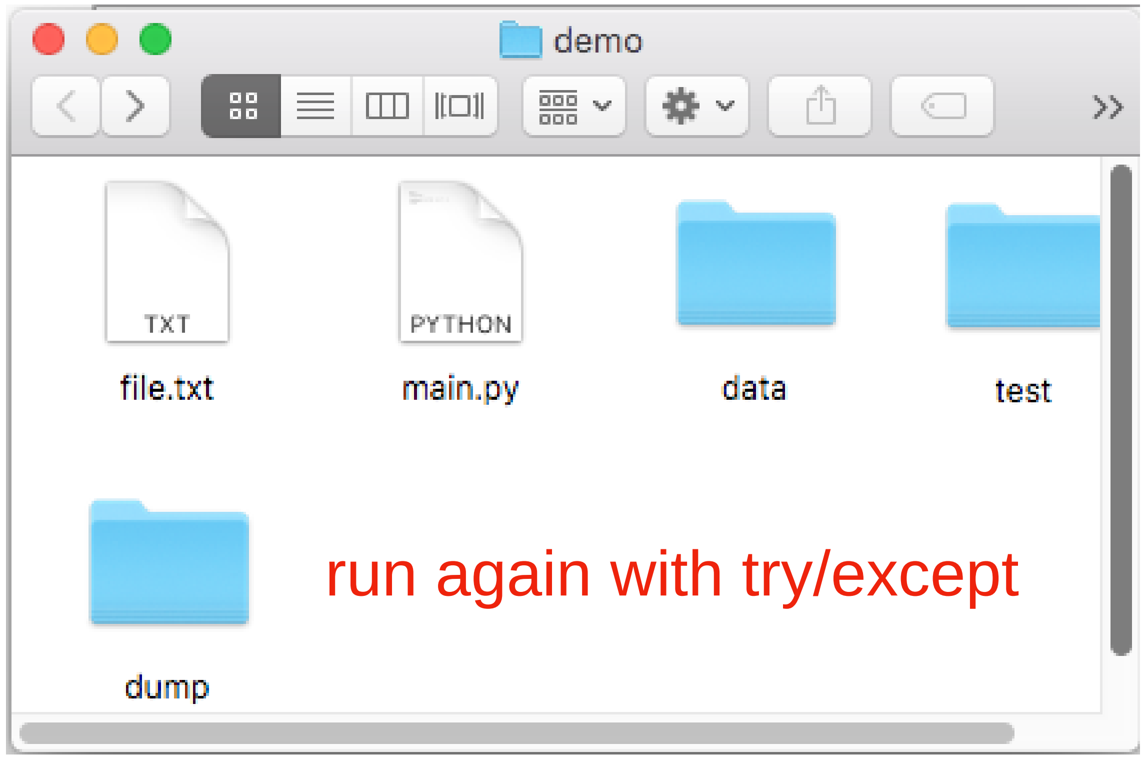
f = open(os.path.join('dump', 'out.txt'), 'w')
f.write('hi')
f.close()
```

```
Traceback (most recent call last):
  File "test2.py", line 3, in <module>
    os.mkdir('dump')
FileExistsError: [Errno 17] File exists: 'dump'
```

Exceptions

Working with files leads to many exceptions

- missing files
- lacking permissions
- not enough space
- mixing up directories and files
- corrupt formats
- etc, etc



run again with try/except

```
import os

try:
   os.mkdir('dump')
except FileExistsError:
   pass # ignore it if dump already existed

f = open(os.path.join('dump', 'out.txt'), 'w')
f.write('hi')
f.close()
```

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Encodings

Exercise: person 1 encodes a word with encoding 1,
person 2 decodes with encoding 2

Word: ukulele

A	00001	N	01110
B	00010	O	01111
C	00011	P	10000
D	00100	Q	10001
E	00000	R	10010
F	00110	S	10011
G	00111	T	10100
H	01000	U	10101
I	01001	V	10110
J	01010	W	10111
K	01011	X	11000
L	11111	Y	11001
M	01101	Z	11010

encoding 1

A	00001	N	01110
B	00010	O	01011
C	00011	P	10000
D	00100	Q	10001
E	00000	R	10010
F	00110	S	10011
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H	01000	U	01100
I	01001	V	10110
J	01010	W	10111
K	01111	X	11000
L	10101	Y	11001
M	01101	Z	11010

encoding 2

Exercise: person 1 encodes a word with encoding 1,
person 2 decodes with encoding 2

Word: ~~ukulele~~
lol?e?e

A	00001	N	01110
B	00010	O	01111
C	00011	P	10000
D	00100	Q	10001
E	00000	R	10010
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G	00111	T	10100
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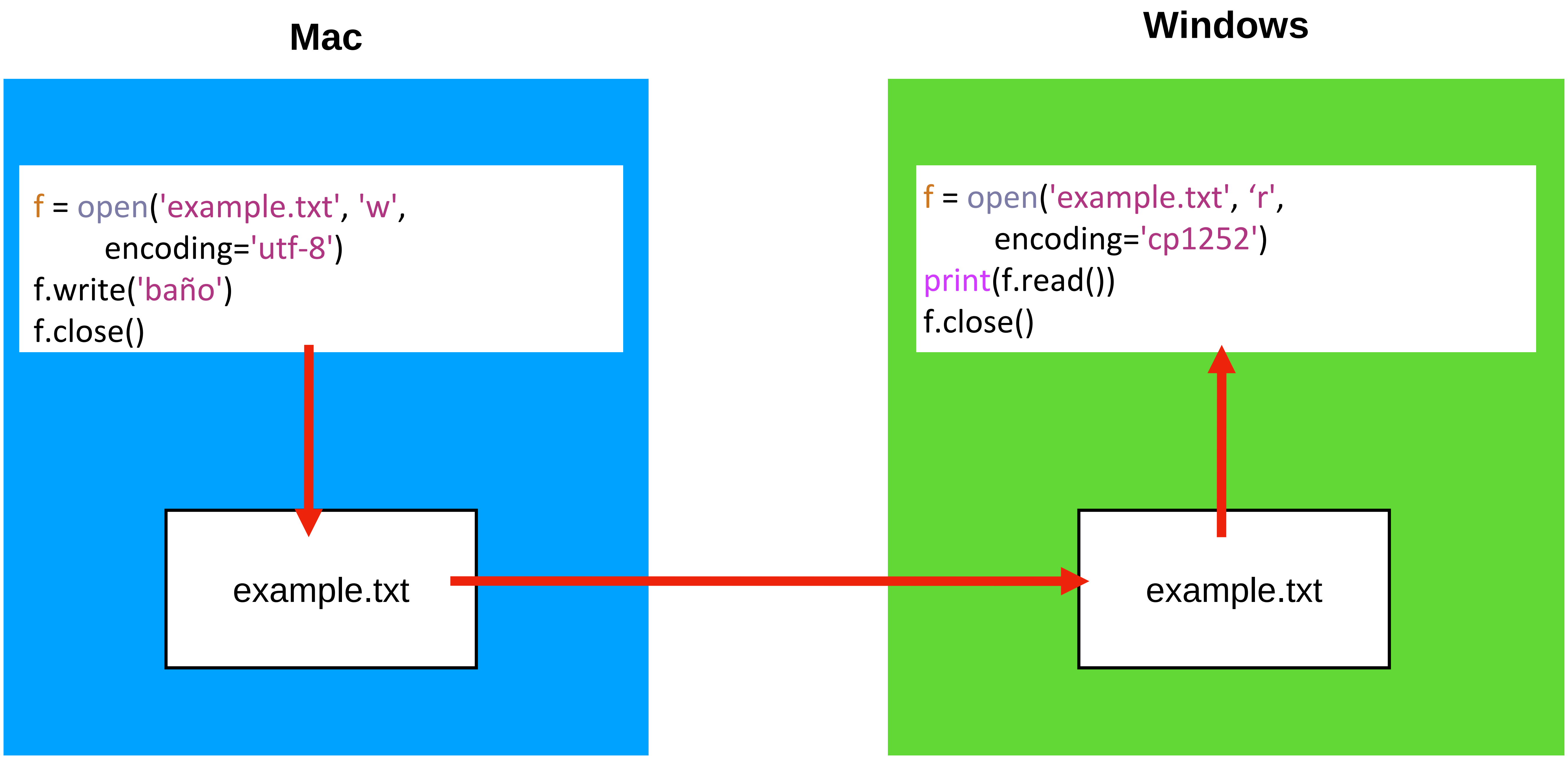
I	01001	V	10110
J	01010	W	10111
K	01011	X	11000
L	11111	Y	11001
M	01101	Z	11010

encoding 1

A	00001	N	01110
B	00010	O	01011
C	00011	P	10000
D	00100	Q	10001
E	00000	R	10010
F	00110	S	10011
G	00111	T	10100
H	01000	U	01100
I	01001	V	10110
J	01010	W	10111
K	01111	X	11000
L	10101	Y	11001
M	01101	Z	11010

encoding 2

Encoding Defaults Done Wrong

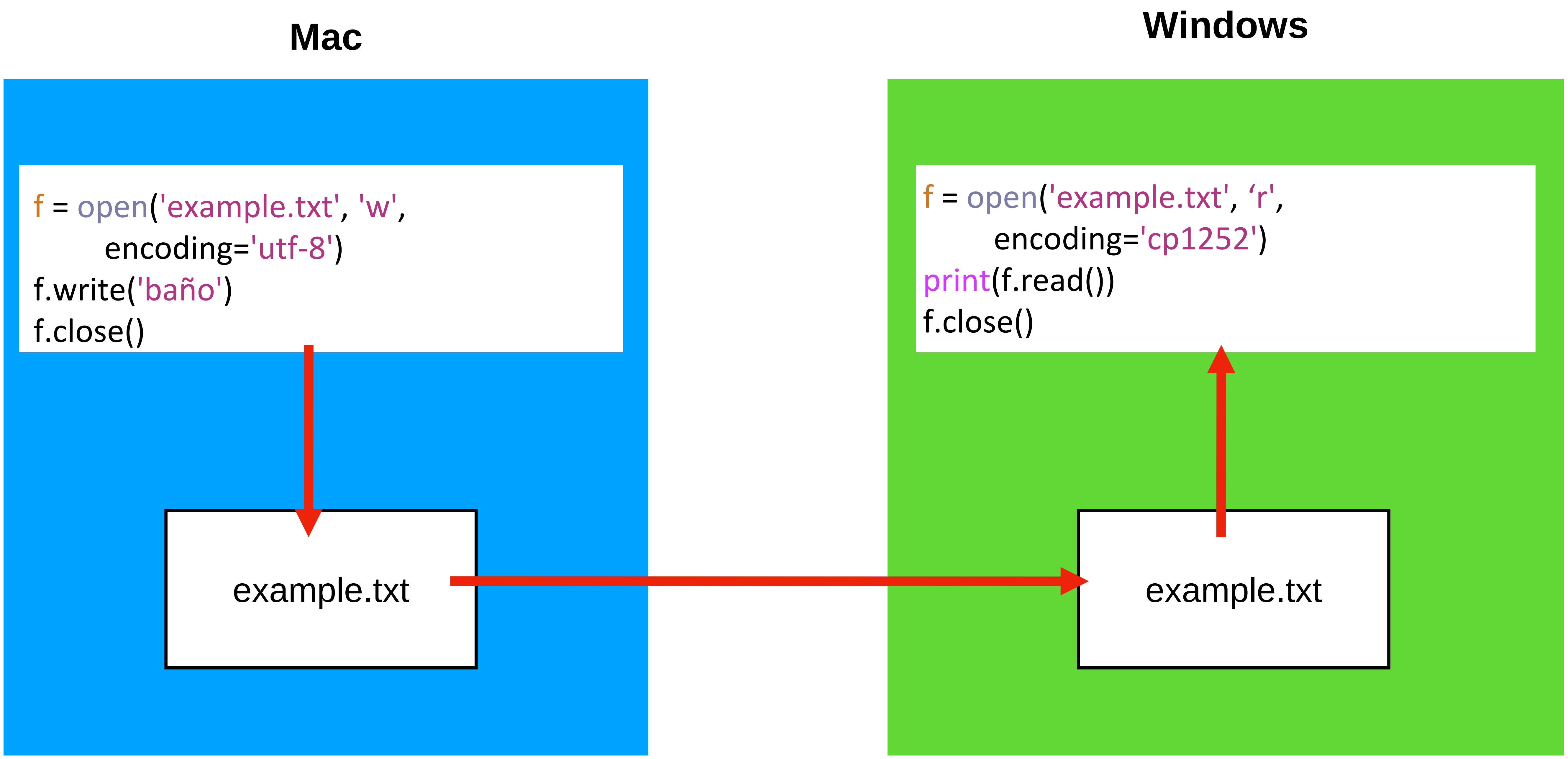


```
f = open('example.txt', 'w',
        encoding='utf-8')
f.write('baño')
f.close()
```

```
f = open('example.txt', ‘r',
        encoding='cp1252')
print(f.read())
f.close()
```

Windows computer prints **“baÃ±o”** instead of **“baño”**

Encoding Defaults Done Wrong



```
f = open('example.txt', 'w',
        encoding='utf-8')
f.write('baño')
f.close()
```

```
f = open('example.txt', ‘r',
        encoding='cp1252')
print(f.read())
f.close()
```

Takeaway: if you see weird characters printed by your program, it’s a good time to learn more about encodings

Coding Demos

Demo 1: add numbers in a file

Goal: read all lines from a file as integers and add them

Input:
- file containing **50 million numbers** between 0 and 100

Output:
- The sum of the numbers

Example:

```
Sum of numbers: 2499463617
```

Two ways:
- Put all lines in a list first
- Directly use iterable file

Bonus: create generator function that does the str => int conversion

Challenge - Demo 1: Score Tracker

Goal: tally up points, and print who is winning

Input:

- Person who just scored

Output:

- Everybody’s score

Example:

```
”Enter winner’s name”: alice
alice: 1

”Enter winner’s name”: bob
alice: 1
bob: 1

”Enter winner’s name”: alice
alice: 2
bob: 1
```

Challenge - Demo 2: File Finder

Goal: search directories (recursively) for a given file name, then print that file

Input:

- The filename to search for

Output:

- The contents of that file

Challenge - Demo 3: sorting files by line length

Goal: output file contents, with shortest line first

Input:
- a text file

Output:
- print lines sorted