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Python

Input and Output - Working with files

Centre for Environmental Data Analysis
SCIENCE AND TECHNOLOGY FACILITIES COUNCIL
NATURAL ENVIRONMENT RESEARCH COUNCIL

software carpentry

National Centre for Atmospheric Science
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National Centre for Earth Observation
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– A file is a sequence of bytes

Been using `print` to see what programs are doing

How to save data to files?

And read data from them?

Python's solution looks very much like C's

- A file is a sequence of bytes
- But it's often more useful to treat it as a sequence of lines

Sample data file: "haiku.txt"

```
Three things are certain:
Death, taxes, and lost data.
Guess which has occurred.

Errors have occurred.
We won't tell you where or why.
Lazy programmers.

With searching comes loss
and the presence of absence:
"My Thesis" not found.

A crash reduces
your expensive computer
to a simple stone.
```

How many characters in a file?

How many ~~characters in~~ a file?

bytes

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bytes ← Assume 1-to-1 for now

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Revisit later

How many characters in a file?

```
with open('haiku.txt', 'r') as reader:
    data = reader.read()
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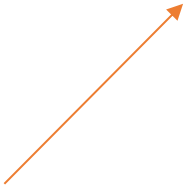

Create a file object

How many characters in a file?

```
with open('haiku.txt', 'r') as reader:
    data = reader.read()
```

File to connect to

How many characters in a file?

```
with open('haiku.txt', 'r') as reader:
    data = reader.read()
```

To read

How many characters in a file?

```
with open('haiku.txt', 'r') as reader:
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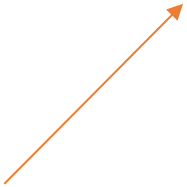

Now holds file object

How many characters in a file?

```
with open('haiku.txt', 'r') as reader:
    data = reader.read()
```

Read entire content

of file into a string

How many characters in a file?

```
with open('haiku.txt', 'r') as reader:
    data = reader.read()
```

Now has a copy of

all the bytes that were

in the file

How many characters in a file?

```
with open('haiku.txt', 'r') as reader:
    data = reader.read()
```

Why don't we need to *close* the file?

Since Python now uses the "with" statement we can trust the file will be automatically closed when we leave the context of the "with" (indented) block.

How many characters in a file?

```
with open('haiku.txt', 'r') as reader:
    data = reader.read()

print(len(data))
```

Report how many characters were read

How many characters in a file?

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with open('haiku.txt', 'r') as reader:
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print(len(data))
```

Report how many

~~characters~~ were read

bytes

How many characters in a file?

```
with open('haiku.txt', 'r') as reader:
    data = reader.read()

print(len(data))
```

```
293
```

If the file might be large, better to read in chunks

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```
with open('haiku.txt', 'r') as reader:
    data = reader.read(64)
    while data != '':
        print(len(data))
        data = reader.read(64)
    print(len(data))
```

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    data = reader.read(64)
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Read (at most) 64 bytes

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        data = reader.read(64)
    print(len(data))
```

Read (at most) 64 bytes

Or the empty string

if there is no more data

If the file might be large, better to read in chunks

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with open('haiku.txt', 'r') as reader:
    data = reader.read(64)
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    print(len(data))
```

Keep looping as long as the last read returned some data

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Do something with the data

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```

(Try to) reload

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```

Should be 0 (or the loop would still be running)

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```

```
64
64
64
64
37
0
```

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Don't do this unless

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        data = reader.read(64)
    print(len(data))
```

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64
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64
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0
```

Don't do this unless the file really

might be very large (or infinite)

More common to read one line at a time

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```
with open('haiku.txt', 'r') as reader:
    line = reader.readline()
    total = 0
    count = 0
    while line != '':
        count += 1
        total += len(line)
        line = reader.readline()

print('average', float(total) / float(count))
```

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print('average', float(total) / float(count))
```

Keep looping until

no more lines in file

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print('average', float(total) / float(count))
```

```
average 19.533333333333335
```

Often more convenient to read all lines at once

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```
with open('haiku.txt', 'r') as reader:
    contents = reader.readlines()
    total = 0
    count = 0
    for line in contents:
        count += 1
        total += len(line)

print('average', float(total) / float(count))
```

Often more convenient to read all lines at once

```
with open('haiku.txt', 'r') as reader:
    contents = reader.readlines()
    total = 0
    count = 0
    for line in contents:
        count += 1
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print('average', float(total) / float(count))
```

All lines in file

as list of strings

Often more convenient to read all lines at once

```
with open('haiku.txt', 'r') as reader:
    contents = reader.readlines()
    total = 0
    count = 0
    for line in contents:
        count += 1
        total += len(line)

print('average', float(total) / float(count))
```

Loop over lines with for

Often more convenient to read all lines at once

```
with open('haiku.txt', 'r') as reader:
    contents = reader.readlines()
    total = 0
    count = 0
    for line in contents:
        count += 1
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print('average', float(total) / float(count))
```

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average 19.533333333333335
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"Read lines as list" + "loop over list" is common idiom

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So Python provides "loop over lines in file"

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"Read lines as list" + "loop over list" is common idiom

So Python provides "loop over lines in file"

```
with open('haiku.txt', 'r') as reader:
    total = 0
    count = 0
    for line in reader:
        count += 1
        total += len(line)

    print('average', float(total) / float(count))
```

Assign lines of text in file

to loop variable one by one

"Read lines as list" + "loop over list" is common idiom

So Python provides "loop over lines in file"

```
with open('haiku.txt', 'r') as reader:
    total = 0
    count = 0
    for line in reader:
        count += 1
        total += len(line)

    print('average', float(total) / float(count))
```

```
average 19.533333333333335
```

Put data in a file using `write` or `writelines`

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```
with open('temp.txt', 'w') as writer:
    writer.write('elements')
    writer.writelines(['He', 'Ne', 'Ar', 'Kr'])
```

Put data in a file using `write` or `writelines`

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Same function

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```

File to write to

(is created if it doesn't exist)

Put data in a file using `write` or `writelines`

```
with open('temp.txt', 'w') as writer:
    writer.write('elements')
    writer.writelines(['He', 'Ne', 'Ar', 'Kr'])
```

For writing instead

of reading

Put data in a file using `write` or `writelines`

```
with open('temp.txt', 'w') as writer:
    writer.write('elements')
    writer.writelines(['He', 'Ne', 'Ar', 'Kr'])
```

Write a single string

Put data in a file using `write` or `writelines`

```
with open('temp.txt', 'w') as writer:
    writer.write('elements')
    writer.writelines(['He', 'Ne', 'Ar', 'Kr'])
```

Write each string

in a list as a line

Put data in a file using `write` or `writelines`

```
with open('temp.txt', 'w') as writer:
    writer.write('elements')
    writer.writelines(['He', 'Ne', 'Ar', 'Kr'])
```

```
elementsHeNeArKr
```

Put data in a file using `write` or `writelines`

```
with open('temp.txt', 'w') as writer:
    writer.write('elements')
    writer.writelines(['He', 'Ne', 'Ar', 'Kr'])
```

```
elementsHeNeArKr
```

Python only writes what you tell it to

Put data in a file using `write` or `writelines`

```
with open('temp.txt', 'w') as writer:
    writer.write('elements\n')
    writer.writelines(['He\n', 'Ne\n', 'Ar\n', 'Kr\n'])
```

Have to provide end-of-line characters yourself

Put data in a file using `write` or `writelines`

```
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    writer.write('elements\n')
    writer.writelines(['He\n', 'Ne\n', 'Ar\n', 'Kr\n'])
```

```
elements
He
Ne
Ar
Kr
```

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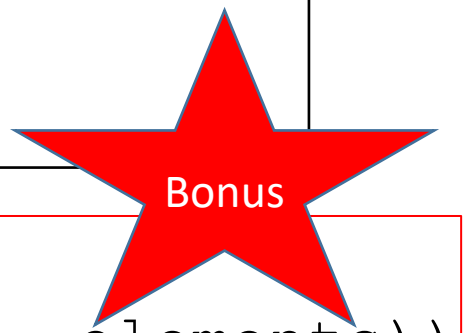
```
with open('temp.txt', 'w') as writer:
    writer.write('elements\n')
    writer.writelines(['He\n', 'Ne\n', 'Ar\n', 'Kr\n'])
```

```
elements
He
Ne
Ar
Kr
```




```
elements = (['He', 'Ne', 'Ar', 'Kr']
writer.writelines(map(lambda x: f'{x)\n', elements))
```

Summary

Reading

```
# Read all data
with open('file.txt', 'r') as reader:
    data = reader.read()

# Read lines, creating a list
with open('file.txt', 'r') as reader:
    lines = reader.readlines()
```

Writing

```
# Write a single line to file
with open('output.txt', 'w') as writer:
    writer.write('some text')

# Make sure that the data you want to write has a \n.
data = ['a\n','b\n','c\n']

# Write multiple lines to file
with open('output.txt', 'w') as writer:
    writer.writelines(data)
```