Ch10-1-Files

October 30, 2020

1 Files Input/Output

- data is usually stored in secondary storage medium such as hard drive, flash drive, cd-rw, etc. using named locations called files
- files can be organized into folders
- programs often need to read data from files and save data back to files for long-term storage
- this chapter demostrates how to read and write plain text files
- use open() built-in function to work with files

```
fileio = open(fileName, mode='r')
```

- open( ) let's you open file in different mode to read (default), write, append, etc.
- see help(open) for details

File I/O can only read and write string data

[1]:
```
help(open)
```

```
Help on built-in function open in module io:

open(file, mode='r', buffering=-1, encoding=None, errors=None, newline=None,
closefd=True, opener=None)
    Open file and return a stream.  Raise OSError upon failure.

    file is either a text or byte string giving the name (and the path
    if the file isn't in the current working directory) of the file to
    be opened or an integer file descriptor of the file to be
    wrapped. (If a file descriptor is given, it is closed when the
    returned I/O object is closed, unless closefd is set to False.)

    mode is an optional string that specifies the mode in which the file
    is opened. It defaults to 'r' which means open for reading in text
    mode.  Other common values are 'w' for writing (truncating the file if
    it already exists), 'x' for creating and writing to a new file, and
    'a' for appending (which on some Unix systems, means that all writes
    append to the end of the file regardless of the current seek position).
    In text mode, if encoding is not specified the encoding used is platform
    dependent: locale.getpreferredencoding(False) is called to get the
    current locale encoding. (For reading and writing raw bytes use binary
    mode and leave encoding unspecified.) The available modes are:
```

```
========= ===================================================================
Character Meaning
--------- -------------------------------------------------------------------
'r'       open for reading (default)
'w'       open for writing, truncating the file first
'x'       create a new file and open it for writing
'a'       open for writing, appending to the end of the file if it exists
'b'       binary mode
't'       text mode (default)
'+'       open a disk file for updating (reading and writing)
'U'       universal newline mode (deprecated)
========= ===================================================================

The default mode is 'rt' (open for reading text). For binary random
access, the mode 'w+b' opens and truncates the file to 0 bytes, while
'r+b' opens the file without truncation. The 'x' mode implies 'w' and
raises an `FileExistsError` if the file already exists.

Python distinguishes between files opened in binary and text modes,
even when the underlying operating system doesn't. Files opened in
binary mode (appending 'b' to the mode argument) return contents as
bytes objects without any decoding. In text mode (the default, or when
't' is appended to the mode argument), the contents of the file are
returned as strings, the bytes having been first decoded using a
platform-dependent encoding or using the specified encoding if given.

'U' mode is deprecated and will raise an exception in future versions
of Python.  It has no effect in Python 3.  Use newline to control
universal newlines mode.

buffering is an optional integer used to set the buffering policy.
Pass 0 to switch buffering off (only allowed in binary mode), 1 to select
line buffering (only usable in text mode), and an integer > 1 to indicate
the size of a fixed-size chunk buffer.  When no buffering argument is
given, the default buffering policy works as follows:

* Binary files are buffered in fixed-size chunks; the size of the buffer
  is chosen using a heuristic trying to determine the underlying device's
  "block size" and falling back on `io.DEFAULT_BUFFER_SIZE`.
  On many systems, the buffer will typically be 4096 or 8192 bytes long.

* "Interactive" text files (files for which isatty() returns True)
  use line buffering.  Other text files use the policy described above
  for binary files.

encoding is the name of the encoding used to decode or encode the
file. This should only be used in text mode. The default encoding is
```

```
platform dependent, but any encoding supported by Python can be
passed.  See the codecs module for the list of supported encodings.

errors is an optional string that specifies how encoding errors are to
be handled---this argument should not be used in binary mode. Pass
'strict' to raise a ValueError exception if there is an encoding error
(the default of None has the same effect), or pass 'ignore' to ignore
errors. (Note that ignoring encoding errors can lead to data loss.)
See the documentation for codecs.register or run 'help(codecs.Codec)'
for a list of the permitted encoding error strings.

newline controls how universal newlines works (it only applies to text
mode). It can be None, '', '\n', '\r', and '\r\n'.  It works as
follows:

* On input, if newline is None, universal newlines mode is
  enabled. Lines in the input can end in '\n', '\r', or '\r\n', and
  these are translated into '\n' before being returned to the
  caller. If it is '', universal newline mode is enabled, but line
  endings are returned to the caller untranslated. If it has any of
  the other legal values, input lines are only terminated by the given
  string, and the line ending is returned to the caller untranslated.

* On output, if newline is None, any '\n' characters written are
  translated to the system default line separator, os.linesep. If
  newline is '' or '\n', no translation takes place. If newline is any
  of the other legal values, any '\n' characters written are translated
  to the given string.

If closefd is False, the underlying file descriptor will be kept open
when the file is closed. This does not work when a file name is given
and must be True in that case.

A custom opener can be used by passing a callable as *opener*. The
underlying file descriptor for the file object is then obtained by
calling *opener* with (*file*, *flags*). *opener* must return an open
file descriptor (passing os.open as *opener* results in functionality
similar to passing None).

open() returns a file object whose type depends on the mode, and
through which the standard file operations such as reading and writing
are performed. When open() is used to open a file in a text mode ('w',
'r', 'wt', 'rt', etc.), it returns a TextIOWrapper. When used to open
a file in a binary mode, the returned class varies: in read binary
mode, it returns a BufferedReader; in write binary and append binary
modes, it returns a BufferedWriter, and in read/write mode, it returns
a BufferedRandom.
```

```
It is also possible to use a string or bytearray as a file for both
reading and writing. For strings StringIO can be used like a file
opened in a text mode, and for bytes a BytesIO can be used like a file
opened in a binary mode.
```

1.1 write text data to a file

3-step process

1. open file with a name in write 'w' or 'a' mode

- write data
- close file

[2]:
```
# old school - not preferred!!
fw = open('test1.txt', 'w') # w is for write mode
fw.write('words\n=====\n')
fw.write('apple\nball\ncat\ndog\n')
print(fw.write('zebra\n'))
fw.close() #must close the file to actually write data
# to the secondoary storage
```

```
6
```

[3]:
```
help(fw)
```

```
Help on TextIOWrapper object:

class TextIOWrapper(_TextIOBase)
 |  TextIOWrapper(buffer, encoding=None, errors=None, newline=None,
line_buffering=False, write_through=False)
 |
 |  Character and line based layer over a BufferedIOBase object, buffer.
 |
 |  encoding gives the name of the encoding that the stream will be
 |  decoded or encoded with. It defaults to locale.getpreferredencoding(False).
 |
 |  errors determines the strictness of encoding and decoding (see
 |  help(codecs.Codec) or the documentation for codecs.register) and
 |  defaults to "strict".
 |
 |  newline controls how line endings are handled. It can be None, '',
 |  '\n', '\r', and '\r\n'.  It works as follows:
 |
 |  * On input, if newline is None, universal newlines mode is
 |    enabled. Lines in the input can end in '\n', '\r', or '\r\n', and
 |    these are translated into '\n' before being returned to the
 |    caller. If it is '', universal newline mode is enabled, but line
 |    endings are returned to the caller untranslated. If it has any of
```

```
|    the other legal values, input lines are only terminated by the given
|    string, and the line ending is returned to the caller untranslated.
|
|  * On output, if newline is None, any '\n' characters written are
|    translated to the system default line separator, os.linesep. If
|    newline is '' or '\n', no translation takes place. If newline is any
|    of the other legal values, any '\n' characters written are translated
|    to the given string.
|
|  If line_buffering is True, a call to flush is implied when a call to
|  write contains a newline character.
|
|  Method resolution order:
|      TextIOWrapper
|      _TextIOBase
|      _IOBase
|      builtins.object
|
|  Methods defined here:
|
|  __getstate__(…)
|
|  __init__(self, /, *args, **kwargs)
|      Initialize self.  See help(type(self)) for accurate signature.
|
|  __next__(self, /)
|      Implement next(self).
|
|  __repr__(self, /)
|      Return repr(self).
|
|  close(self, /)
|      Flush and close the IO object.
|
|      This method has no effect if the file is already closed.
|
|  detach(self, /)
|      Separate the underlying buffer from the TextIOBase and return it.
|
|      After the underlying buffer has been detached, the TextIO is in an
|      unusable state.
|
|  fileno(self, /)
|      Returns underlying file descriptor if one exists.
|
|      OSError is raised if the IO object does not use a file descriptor.
|
|  flush(self, /)
```

```
 |      Flush write buffers, if applicable.
 |
 |      This is not implemented for read-only and non-blocking streams.
 |
 |  isatty(self, /)
 |      Return whether this is an 'interactive' stream.
 |
 |      Return False if it can't be determined.
 |
 |  read(self, size=-1, /)
 |      Read at most n characters from stream.
 |
 |      Read from underlying buffer until we have n characters or we hit EOF.
 |      If n is negative or omitted, read until EOF.
 |
 |  readable(self, /)
 |      Return whether object was opened for reading.
 |
 |      If False, read() will raise OSError.
 |
 |  readline(self, size=-1, /)
 |      Read until newline or EOF.
 |
 |      Returns an empty string if EOF is hit immediately.
 |
 |  reconfigure(self, /, *, encoding=None, errors=None, newline=None,
line_buffering=None, write_through=None)
 |      Reconfigure the text stream with new parameters.
 |
 |      This also does an implicit stream flush.
 |
 |  seek(self, cookie, whence=0, /)
 |      Change stream position.
 |
 |      Change the stream position to the given byte offset. The offset is
 |      interpreted relative to the position indicated by whence.  Values
 |      for whence are:
 |
 |      * 0 -- start of stream (the default); offset should be zero or positive
 |      * 1 -- current stream position; offset may be negative
 |      * 2 -- end of stream; offset is usually negative
 |
 |      Return the new absolute position.
 |
 |  seekable(self, /)
 |      Return whether object supports random access.
 |
 |      If False, seek(), tell() and truncate() will raise OSError.
```

```
|      This method may need to do a test seek().
|
|  tell(self, /)
|      Return current stream position.
|
|  truncate(self, pos=None, /)
|      Truncate file to size bytes.
|
|      File pointer is left unchanged.  Size defaults to the current IO
|      position as reported by tell().  Returns the new size.
|
|  writable(self, /)
|      Return whether object was opened for writing.
|
|      If False, write() will raise OSError.
|
|  write(self, text, /)
|      Write string to stream.
|      Returns the number of characters written (which is always equal to
|      the length of the string).
|
|  ----------------------------------------------------------------------
|  Static methods defined here:
|
|  __new__(*args, **kwargs) from builtins.type
|      Create and return a new object.  See help(type) for accurate signature.
|
|  ----------------------------------------------------------------------
|  Data descriptors defined here:
|
|  buffer
|
|  closed
|
|  encoding
|      Encoding of the text stream.
|
|      Subclasses should override.
|
|  errors
|      The error setting of the decoder or encoder.
|
|      Subclasses should override.
|
|  line_buffering
|
|  name
|
```

```
|  newlines
|      Line endings translated so far.
|
|      Only line endings translated during reading are considered.
|
|      Subclasses should override.
|
|  write_through
|
|  ----------------------------------------------------------------------
|  Methods inherited from _IOBase:
|
|  __del__(…)
|
|  __enter__(…)
|
|  __exit__(…)
|
|  __iter__(self, /)
|      Implement iter(self).
|
|  readlines(self, hint=-1, /)
|      Return a list of lines from the stream.
|
|      hint can be specified to control the number of lines read: no more
|      lines will be read if the total size (in bytes/characters) of all
|      lines so far exceeds hint.
|
|  writelines(self, lines, /)
|
|  ----------------------------------------------------------------------
|  Data descriptors inherited from _IOBase:
|
|  __dict__
```

[4]:
```python
# newer and better syntax - preferred way!!
alist = [1, 2, 3]
with open('words.txt', 'w') as fout:
    fout.write('apple\nball\ncat\ndog\n')
    fout.write('elephant\n')
    fout.write('zebra\n')
    fout.write(str(1))
    fout.write('\n')
    fout.write(str(alist))
```

```
# file will be automatically closed when with block is finished executing
# fout.write('test\n') # this will not be written as the file is closed; and␣
 ↪throws I/O error
```

1.2 read text data from a file

1. open file with its name; can provide relative or absolute path

- read in various ways; one line at a time, all lines, bytes, whole file, etc.
- use data
- close file

1.2.1 various ways to read data

1. read(size=-1) : read at most size characters from stream or EOF (End of File) marker
2. readline() : read until newline or EOF marker
3. readlines() : read and return a list of lines from the input file

[5]:
```
# read whole file as list of lines
fr = open('words.txt', 'r') # 'r' or read mode by default; file must exist
data = fr.readlines()
fr.close()
```

[6]:
```
data[0].strip()
```

[6]:
```
'apple'
```

[7]:
```
with open('words.txt', 'r') as fr:
    data= fr.readlines()
```

[8]:
```
help(fr)
```

```
Help on TextIOWrapper object:

class TextIOWrapper(_TextIOBase)
 |  TextIOWrapper(buffer, encoding=None, errors=None, newline=None,
line_buffering=False, write_through=False)
 |
 |  Character and line based layer over a BufferedIOBase object, buffer.
 |
 |  encoding gives the name of the encoding that the stream will be
 |  decoded or encoded with. It defaults to locale.getpreferredencoding(False).
 |
 |  errors determines the strictness of encoding and decoding (see
 |  help(codecs.Codec) or the documentation for codecs.register) and
 |  defaults to "strict".
 |
 |  newline controls how line endings are handled. It can be None, '',
```

```
|  '\n', '\r', and '\r\n'.  It works as follows:
|
|  * On input, if newline is None, universal newlines mode is
|    enabled. Lines in the input can end in '\n', '\r', or '\r\n', and
|    these are translated into '\n' before being returned to the
|    caller. If it is '', universal newline mode is enabled, but line
|    endings are returned to the caller untranslated. If it has any of
|    the other legal values, input lines are only terminated by the given
|    string, and the line ending is returned to the caller untranslated.
|
|  * On output, if newline is None, any '\n' characters written are
|    translated to the system default line separator, os.linesep. If
|    newline is '' or '\n', no translation takes place. If newline is any
|    of the other legal values, any '\n' characters written are translated
|    to the given string.
|
|  If line_buffering is True, a call to flush is implied when a call to
|  write contains a newline character.
|
|  Method resolution order:
|      TextIOWrapper
|      _TextIOBase
|      _IOBase
|      builtins.object
|
|  Methods defined here:
|
|  __getstate__(…)
|
|  __init__(self, /, *args, **kwargs)
|      Initialize self.  See help(type(self)) for accurate signature.
|
|  __next__(self, /)
|      Implement next(self).
|
|  __repr__(self, /)
|      Return repr(self).
|
|  close(self, /)
|      Flush and close the IO object.
|
|      This method has no effect if the file is already closed.
|
|  detach(self, /)
|      Separate the underlying buffer from the TextIOBase and return it.
|
|      After the underlying buffer has been detached, the TextIO is in an
|      unusable state.
```

```
 |
 |  fileno(self, /)
 |      Returns underlying file descriptor if one exists.
 |
 |      OSError is raised if the IO object does not use a file descriptor.
 |
 |  flush(self, /)
 |      Flush write buffers, if applicable.
 |
 |      This is not implemented for read-only and non-blocking streams.
 |
 |  isatty(self, /)
 |      Return whether this is an 'interactive' stream.
 |
 |      Return False if it can't be determined.
 |
 |  read(self, size=-1, /)
 |      Read at most n characters from stream.
 |
 |      Read from underlying buffer until we have n characters or we hit EOF.
 |      If n is negative or omitted, read until EOF.
 |
 |  readable(self, /)
 |      Return whether object was opened for reading.
 |
 |      If False, read() will raise OSError.
 |
 |  readline(self, size=-1, /)
 |      Read until newline or EOF.
 |
 |      Returns an empty string if EOF is hit immediately.
 |
 |  reconfigure(self, /, *, encoding=None, errors=None, newline=None,
line_buffering=None, write_through=None)
 |      Reconfigure the text stream with new parameters.
 |
 |      This also does an implicit stream flush.
 |
 |  seek(self, cookie, whence=0, /)
 |      Change stream position.
 |
 |      Change the stream position to the given byte offset. The offset is
 |      interpreted relative to the position indicated by whence.  Values
 |      for whence are:
 |
 |      * 0 -- start of stream (the default); offset should be zero or positive
 |      * 1 -- current stream position; offset may be negative
 |      * 2 -- end of stream; offset is usually negative
```

```
|
|      Return the new absolute position.
|
|  seekable(self, /)
|      Return whether object supports random access.
|
|      If False, seek(), tell() and truncate() will raise OSError.
|      This method may need to do a test seek().
|
|  tell(self, /)
|      Return current stream position.
|
|  truncate(self, pos=None, /)
|      Truncate file to size bytes.
|
|      File pointer is left unchanged.  Size defaults to the current IO
|      position as reported by tell().  Returns the new size.
|
|  writable(self, /)
|      Return whether object was opened for writing.
|
|      If False, write() will raise OSError.
|
|  write(self, text, /)
|      Write string to stream.
|      Returns the number of characters written (which is always equal to
|      the length of the string).
|
|  ----------------------------------------------------------------------
|  Static methods defined here:
|
|  __new__(*args, **kwargs) from builtins.type
|      Create and return a new object.  See help(type) for accurate signature.
|
|  ----------------------------------------------------------------------
|  Data descriptors defined here:
|
|  buffer
|
|  closed
|
|  encoding
|      Encoding of the text stream.
|
|      Subclasses should override.
|
|  errors
|      The error setting of the decoder or encoder.
```

```
|
|      Subclasses should override.
|
|  line_buffering
|
|  name
|
|  newlines
|      Line endings translated so far.
|
|      Only line endings translated during reading are considered.
|
|      Subclasses should override.
|
|  write_through
|
|  ----------------------------------------------------------------------
|  Methods inherited from _IOBase:
|
|  __del__(…)
|
|  __enter__(…)
|
|  __exit__(…)
|
|  __iter__(self, /)
|      Implement iter(self).
|
|  readlines(self, hint=-1, /)
|      Return a list of lines from the stream.
|
|      hint can be specified to control the number of lines read: no more
|      lines will be read if the total size (in bytes/characters) of all
|      lines so far exceeds hint.
|
|  writelines(self, lines, /)
|
|  ----------------------------------------------------------------------
|  Data descriptors inherited from _IOBase:
|
|  __dict__
```

[9]:
```
data
```

[9]:
```
['apple\n',
 'ball\n',
```

```
 'cat\n',
 'dog\n',
 'elephant\n',
 'zebra\n',
 '1\n',
 '[1, 2, 3]']
```

[10]:
```
for el in data:
    print(el.strip())
```

```
apple
ball
cat
dog
elephant
zebra
1
[1, 2, 3]
```

[11]:
```
data.sort()
```

[12]:
```
data
```

[12]:
```
['1\n',
 '[1, 2, 3]',
 'apple\n',
 'ball\n',
 'cat\n',
 'dog\n',
 'elephant\n',
 'zebra\n']
```

[13]:
```
with open('words1.txt', 'w') as newFile:
    for word in data:
        newFile.write(word)
```

1.3 read data line by line

- let's create a file with about 10 integers one per line
- then, read the integer line by line into a list of integers

[14]:
```
# create a file with 10 integers
# one integer per line
import random
with open('integers.txt', 'a') as fout:
    for i in range(10):
```

```
        num = random.randint(1, 1000)
        fout.write(str(num) + '\n')
```

[15]:
```
# read the integer line by line into a list
intList = []
with open('integers.txt', 'r') as fin:
    while True:
        num = fin.readline()
        num = num.strip() # strip \n
        if not num:
            break
        print('num = ', num, type(num))
        intList.append(int(num))
```

```
num =  462 <class 'str'>
num =  298 <class 'str'>
num =  188 <class 'str'>
num =  560 <class 'str'>
num =  431 <class 'str'>
num =  279 <class 'str'>
num =  488 <class 'str'>
num =  173 <class 'str'>
num =  160 <class 'str'>
num =  502 <class 'str'>
```

[16]:
```
print(intList)
```

```
[462, 298, 188, 560, 431, 279, 488, 173, 160, 502]
```

1.4 reading the whole file at once

- read /usr/share/dict/words file on linux/mac
- windows path might be "C:/temp/words.txt" or c:\temp\words.txt"
- if the file doesn't exist, use provided words.txt file or create a text file with a bunch of words in it using an editor

[18]:
```
# read first 10 lines using head program
! head /usr/share/dict/words
```

```
A
a
aa
aal
aalii
aam
Aani
aardvark
aardwolf
```

```
Aaron
```

[17]:
```
# read last 10 lines using head program
! tail /usr/share/dict/words
```

```
zymotoxic
zymurgy
Zyrenian
Zyrian
Zyryan
zythem
Zythia
zythum
Zyzomys
Zyzzogeton
```

[19]:
```
file = '/usr/share/dict/words' # works on mac/linux
with open(file) as f:
    data = f.read()
```

[20]:
```
data
```

[20]:
```
'A\na\naa\naal\naalii\naam\nAani\naardvark\naardwolf\nAaron\nAaronic\nAaronical\
nAaronite\nAaronitic\nAaru\nAb\naba\nAbabdeh\nAbabua\nabac\nabaca\nabacate\nabac
ay\nabacinate\nabacination\nabaciscus\nabacist\naback\nabactinal\nabactinally\na
baction\nabactor\nabaculus\nabacus\nAbadite\nabaff\nabaft\nabaisance\nabaiser\na
baissed\nabalienate\nabalienation\nabalone\nAbama\nabampere\nabandon\nabandonabl
e\nabandoned\nabandonedly\nabandonee\nabandoner\nabandonment\nAbanic\nAbantes\na
baptiston\nAbarambo\nAbaris\nabarthrosis\nabarticular\nabarticulation\nabas\naba
se\nabased\nabasedly\nabasedness\nabasement\nabaser\nAbasgi\nabash\nabashed\naba
shedly\nabashedness\nabashless\nabashlessly\nabashment\nabasia\nabasic\nabask\nA
bassin\nabastardize\nabatable\nabate\nabatement\nabater\nabatis\nabatised\nabato
n\nabator\nabattoir\nAbatua\nabature\nabave\nabaxial\nabaxile\nabaze\nabb\nAbba\
nabbacomes\nabbacy\nAbbadide\nabbas\nabbasi\nabbassi\nAbbasside\nabbatial\nabbat
ical\nabbess\nabbey\nabbeystede\nAbbie\nabbot\nabbotcy\nabbotnullius\nabbotship\
nabbreviate\nabbreviately\nabbreviation\nabbreviator\nabbreviatory\nabbreviature
\nAbby\nabcoulomb\nabdal\nabdat\nAbderian\nAbderite\nabdest\nabdicable\nabdicant
\nabdicate\nabdication\nabdicative\nabdicator\nAbdiel\nabditive\nabditory\nabdom
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on\nacotyledonous\nacouasm\nacouchi\nacouchy\nacoumeter\nacoumetry\nacouometer\n
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acoustician\nacousticolateral\nAcousticon\nacoustics\nacquaint\nacquaintance\nac
quaintanceship\nacquaintancy\nacquaintant\nacquainted\nacquaintedness\nacquest\n
acquiesce\nacquiescement\nacquiescence\nacquiescency\nacquiescent\nacquiescently
\nacquiescer\nacquiescingly\nacquirability\nacquirable\nacquire\nacquired\nacqui
rement\nacquirenda\nacquirer\nacquisible\nacquisite\nacquisited\nacquisition\nac
quisitive\nacquisitively\nacquisitiveness\nacquisitor\nacquisitum\nacquist\nacqu
it\nacquitment\nacquittal\nacquittance\nacquitter\nAcrab\nacracy\nacraein\nAcrae
inae\nacraldehyde\nAcrania\nacranial\nacraniate\nacrasia\nAcrasiaceae\nAcrasiale
s\nAcrasida\nAcrasieae\nAcraspeda\nacraspedote\nacratia\nacraturesis\nacrawl\nac
raze\nacre\nacreable\nacreage\nacreak\nacream\nacred\nAcredula\nacreman\nacresta
ff\nacrid\nacridan\nacridian\nacridic\nAcrididae\nAcridiidae\nacridine\nacridini
c\nacridinium\nacridity\nAcridium\nacridly\nacridness\nacridone\nacridonium\nacr
idophagus\nacridyl\nacriflavin\nacriflavine\nacrimonious\nacrimoniously\nacrimon
iousness\nacrimony\nacrindoline\nacrinyl\nacrisia\nAcrisius\nAcrita\nacritan\nac
rite\nacritical\nacritol\nAcroa\nacroaesthesia\nacroama\nacroamatic\nacroamatics
\nacroanesthesia\nacroarthritis\nacroasphyxia\nacroataxia\nacroatic\nacrobacy\na
crobat\nAcrobates\nacrobatholithic\nacrobatic\nacrobatical\nacrobatically\nacrob
atics\nacrobatism\nacroblast\nacrobryous\nacrobystitis\nAcrocarpi\nacrocarpous\n
acrocephalia\nacrocephalic\nacrocephalous\nacrocephaly\nAcrocera\nAcroceratidae\
nAcroceraunian\nAcroceridae\nAcrochordidae\nAcrochordinae\nacrochordon\nAcroclin
ium\nAcrocomia\nacroconidium\nacrocontracture\nacrocoracoid\nacrocyanosis\nacroc
yst\nacrodactylum\nacrodermatitis\nacrodont\nacrodontism\nacrodrome\nacrodromous
\nAcrodus\nacrodynia\nacroesthesia\nacrogamous\nacrogamy\nacrogen\nacrogenic\nac
rogenous\nacrogenously\nacrography\nAcrogynae\nacrogynae\nacrogynous\nacrolein\n
acrolith\nacrolithan\nacrolithic\nacrologic\nacrologically\nacrologism\nacrologu
e\nacrology\nacromania\nacromastitis\nacromegalia\nacromegalic\nacromegaly\nacro
melalgia\nacrometer\nacromial\nacromicria\nacromioclavicular\nacromiocoracoid\na

cromiodeltoid\nacromiohumeral\nacromiohyoid\nacromion\nacromioscapular\nacromios
ternal\nacromiothoracic\nacromonogrammatic\nacromphalus\nAcromyodi\nacromyodian\
nacromyodic\nacromyodous\nacromyotonia\nacromyotonus\nacron\nacronarcotic\nacron
eurosis\nacronical\nacronically\nacronyc\nacronych\nAcronycta\nacronyctous\nacro
nym\nacronymic\nacronymize\nacronymous\nacronyx\nacrook\nacroparalysis\nacropare
sthesia\nacropathology\nacropathy\nacropetal\nacropetally\nacrophobia\nacrophone
tic\nacrophonic\nacrophony\nacropodium\nacropoleis\nacropolis\nacropolitan\nAcro
pora\nacrorhagus\nacrorrheuma\nacrosarc\nacrosarcum\nacroscleriasis\nacrosclerod
erma\nacroscopic\nacrose\nacrosome\nacrosphacelus\nacrospire\nacrospore\nacrospo
rous\nacross\nacrostic\nacrostical\nacrostically\nacrostichal\nAcrosticheae\nacr
ostichic\nacrostichoid\nAcrostichum\nacrosticism\nacrostolion\nacrostolium\nacro
tarsial\nacrotarsium\nacroteleutic\nacroterial\nacroteric\nacroterium\nAcrothora
cica\nacrotic\nacrotism\nacrotomous\nAcrotreta\nAcrotretidae\nacrotrophic\nacrot
rophoneurosis\nAcrux\nAcrydium\nacryl\nacrylaldehyde\nacrylate\nacrylic\nacrylon
itrile\nacrylyl\nact\nacta\nactability\nactable\nActaea\nActaeaceae\nActaeon\nAc
taeonidae\nActiad\nActian\nactification\nactifier\nactify\nactin\nactinal\nactin
ally\nactinautographic\nactinautography\nactine\nactinenchyma\nacting\nActinia\n
actinian\nActiniaria\nactiniarian\nactinic\nactinically\nActinidia\nActinidiacea
e\nactiniferous\nactiniform\nactinine\nactiniochrome\nactiniohematin\nActiniomor
pha\nactinism\nActinistia\nactinium\nactinobacillosis\nActinobacillus\nactinobla
st\nactinobranch\nactinobranchia\nactinocarp\nactinocarpic\nactinocarpous\nactin
ochemistry\nactinocrinid\nActinocrinidae\nactinocrinite\nActinocrinus\nactinocut
itis\nactinodermatitis\nactinodielectric\nactinodrome\nactinodromous\nactinoelec
tric\nactinoelectrically\nactinoelectricity\nactinogonidiate\nactinogram\nactino
graph\nactinography\nactinoid\nActinoida\nActinoidea\nactinolite\nactinolitic\na
ctinologous\nactinologue\nactinology\nactinomere\nactinomeric\nactinometer\nacti
nometric\nactinometrical\nactinometry\nactinomorphic\nactinomorphous\nactinomorp
hy\nActinomyces\nActinomycetaceae\nActinomycetales\nactinomycete\nactinomycetous
\nactinomycin\nactinomycoma\nactinomycosis\nactinomycotic\nActinomyxidia\nActino
myxidiida\nactinon\nActinonema\nactinoneuritis\nactinophone\nactinophonic\nactin
ophore\nactinophorous\nactinophryan\nActinophrys\nActinopoda\nactinopraxis\nacti
nopteran\nActinopteri\nactinopterous\nactinopterygian\nActinopterygii\nactinopte
rygious\nactinoscopy\nactinosoma\nactinosome\nActinosphaerium\nactinost\nactinos
tereoscopy\nactinostomal\nactinostome\nactinotherapeutic\nactinotherapeutics\nac
tinotherapy\nactinotoxemia\nactinotrichium\nactinotrocha\nactinouranium\nActinoz
oa\nactinozoal\nactinozoan\nactinozoon\nactinula\naction\nactionable\nactionably
\nactional\nactionary\nactioner\nactionize\nactionless\nActipylea\nActium\nactiv
able\nactivate\nactivation\nactivator\nactive\nactively\nactiveness\nactivin\nac
tivism\nactivist\nactivital\nactivity\nactivize\nactless\nactomyosin\nacton\nact
or\nactorship\nactress\nActs\nactu\nactual\nactualism\nactualist\nactualistic\na
ctuality\nactualization\nactualize\nactually\nactualness\nactuarial\nactuarially
\nactuarian\nactuary\nactuaryship\nactuation\nactuator\nacture\nacturience\nactu
tate\nacuaesthesia\nAcuan\nacuate\nacuation\nAcubens\nacuclosure\nacuductor\nacu
esthesia\nacuity\naculea\nAculeata\naculeate\naculeated\naculeiform\naculeolate\
naculeolus\naculeus\nacumen\nacuminate\nacumination\nacuminose\nacuminous\nacumi
nulate\nacupress\nacupressure\nacupunctuate\nacupunctuation\nacupuncturation\nac
upuncturator\nacupuncture\nacurative\nacushla\nacutangular\nacutate\nacute\nacut

ely\nacutenaculum\nacuteness\nacutiator\nacutifoliate\nAcutilinguae\nacutilingua
l\nacutilobate\nacutiplantar\nacutish\nacutograve\nacutonodose\nacutorsion\nacya
noblepsia\nacyanopsia\nacyclic\nacyesis\nacyetic\nacyl\nacylamido\nacylamidobenz
ene\nacylamino\nacylate\nacylation\nacylogen\nacyloin\nacyloxy\nacyloxymethane\n
acyrological\nacyrology\nacystia\nad\nAda\nadactyl\nadactylia\nadactylism\nadact
ylous\nAdad\nadad\nadage\nadagial\nadagietto\nadagio\nAdai\nAdaize\nAdam\nadaman
t\nadamantean\nadamantine\nadamantinoma\nadamantoblast\nadamantoblastoma\nadaman
toid\nadamantoma\nadamas\nAdamastor\nadambulacral\nadamellite\nAdamhood\nAdamic\
nAdamical\nAdamically\nadamine\nAdamite\nadamite\nAdamitic\nAdamitical\nAdamitis
m\nAdamsia\nadamsite\nadance\nadangle\nAdansonia\nAdapa\nadapid\nAdapis\nadapt\n
adaptability\nadaptable\nadaptation\nadaptational\nadaptationally\nadaptative\na
daptedness\nadapter\nadaption\nadaptional\nadaptionism\nadaptitude\nadaptive\nad
aptively\nadaptiveness\nadaptometer\nadaptor\nadaptorial\nAdar\nadarme\nadat\nad
ati\nadatom\nadaunt\nadaw\nadawe\nadawlut\nadawn\nadaxial\naday\nadays\nadazzle\
nadcraft\nadd\nAdda\nadda\naddability\naddable\naddax\naddebted\nadded\naddedly\
naddend\naddenda\naddendum\nadder\nadderbolt\nadderfish\nadderspit\nadderwort\na
ddibility\naddible\naddicent\naddict\naddicted\naddictedness\naddiction\nAddie\n
addiment\nAddisonian\nAddisoniana\nadditament\nadditamentary\naddition\naddition
al\nadditionally\nadditionary\nadditionist\nadditious\nadditive\nadditively\na
dditivity\nadditory\naddle\naddlebrain\naddlebrained\naddlehead\naddleheaded\nad
dleheadedly\naddleheadedness\naddlement\naddleness\naddlepate\naddlepated\naddle
patedness\naddleplot\naddlings\naddlins\naddorsed\naddress\naddressee\naddresser
\naddressful\nAddressograph\naddressor\naddrest\nAddu\nadduce\nadducent\nadducer
\nadducible\nadduct\nadduction\nadductive\nadductor\nAddy\nAde\nade\nadead\nadee
m\nadeep\nAdela\nAdelaide\nAdelarthra\nAdelarthrosomata\nadelarthrosomatous\nAde
lbert\nAdelea\nAdeleidae\nAdelges\nAdelia\nAdelina\nAdeline\nadeling\nadelite\nA
deliza\nadelocerous\nAdelochorda\nadelocodonic\nadelomorphic\nadelomorphous\nade
lopod\nAdelops\nAdelphi\nAdelphian\nadelphogamy\nAdelphoi\nadelpholite\nadelphop
hagy\nademonist\nadempted\nademption\nadenalgia\nadenalgy\nAdenanthera\nadenase\
nadenasthenia\nadendric\nadendritic\nadenectomy\nadenectopia\nadenectopic\nadene
mphractic\nadenemphraxis\nadenia\nadeniform\nadenine\nadenitis\nadenization\nade
noacanthoma\nadenoblast\nadenocancroid\nadenocarcinoma\nadenocarcinomatous\naden
ocele\nadenocellulitis\nadenochondroma\nadenochondrosarcoma\nadenochrome\nadenoc
yst\nadenocystoma\nadenocystomatous\nadenodermia\nadenodiastasis\nadenodynia\nad
enofibroma\nadenofibrosis\nadenogenesis\nadenogenous\nadenographer\nadenographic
\nadenographical\nadenography\nadenohypersthenia\nadenoid\nadenoidal\nadenoidism
\nadenoliomyofibroma\nadenolipoma\nadenolipomatosis\nadenologaditis\nadenologica
l\nadenology\nadenolymphocele\nadenolymphoma\nadenoma\nadenomalacia\nadenomatome
\nadenomatous\nadenomeningeal\nadenometritis\nadenomycosis\nadenomyofibroma\nade
nomyoma\nadenomyxoma\nadenomyxosarcoma\nadenoncus\nadenoneural\nadenoneure\naden
opathy\nadenopharyngeal\nadenopharyngitis\nadenophlegmon\nAdenophora\nadenophore
\nadenophorous\nadenophthalmia\nadenophyllous\nadenophyma\nadenopodous\nadenosar
coma\nadenosclerosis\nadenose\nadenosine\nadenosis\nadenostemonous\nAdenostoma\n
adenotome\nadenotomic\nadenotomy\nadenotyphoid\nadenotyphus\nadenyl\nadenylic\nA
deodatus\nAdeona\nAdephaga\nadephagan\nadephagia\nadephagous\nadept\nadeptness\n
adeptship\nadequacy\nadequate\nadequately\nadequateness\nadequation\nadequative\
nadermia\nadermin\nAdessenarian\nadet\nadevism\nadfected\nadfix\nadfluxion\nadgl

utinate\nAdhafera\nadhaka\nadhamant\nAdhara\nadharma\nadhere\nadherence\nadheren
cy\nadherent\nadherently\nadherer\nadherescence\nadherescent\nadhesion\nadhesion
al\nadhesive\nadhesively\nadhesivemeter\nadhesiveness\nadhibit\nadhibition\nadia
batic\nadiabatically\nadiabolist\nadiactinic\nadiadochokinesis\nadiagnostic\nadi
antiform\nAdiantum\nadiaphon\nadiaphonon\nadiaphoral\nadiaphoresis\nadiaphoretic
\nadiaphorism\nadiaphorist\nadiaphoristic\nadiaphorite\nadiaphoron\nadiaphorous\
nadiate\nadiathermal\nadiathermancy\nadiathermanous\nadiathermic\nadiathetic\nad
iation\nAdib\nAdicea\nadicity\nAdiel\nadieu\nadieux\nAdigei\nAdighe\nAdigranth\n
adigranth\nAdin\nAdinida\nadinidan\nadinole\nadion\nadipate\nadipescent\nadipic\
nadipinic\nadipocele\nadipocellulose\nadipocere\nadipoceriform\nadipocerous\nadi
pocyte\nadipofibroma\nadipogenic\nadipogenous\nadipoid\nadipolysis\nadipolytic\n
adipoma\nadipomatous\nadipometer\nadipopexia\nadipopexis\nadipose\nadiposeness\n
adiposis\nadiposity\nadiposogenital\nadiposuria\nadipous\nadipsia\nadipsic\nadip
sous\nadipsy\nadipyl\nAdirondack\nadit\nadital\naditus\nadjacency\nadjacent\nadj
acently\nadjag\nadject\nadjection\nadjectional\nadjectival\nadjectivally\nadject
ive\nadjectively\nadjectivism\nadjectivitis\nadjiger\nadjoin\nadjoined\nadjoined
ly\nadjoining\nadjoint\nadjourn\nadjournal\nadjournment\nadjudge\nadjudgeable\na
djudger\nadjudgment\nadjudicate\nadjudication\nadjudicative\nadjudicator\nadjudi
cature\nadjunct\nadjunction\nadjunctive\nadjunctively\nadjunctly\nadjuration\nad
juratory\nadjure\nadjurer\nadjust\nadjustable\nadjustably\nadjustage\nadjustatio
n\nadjuster\nadjustive\nadjustment\nadjutage\nadjutancy\nadjutant\nadjutantship\
nadjutorious\nadjutory\nadjutrice\nadjuvant\nAdlai\nadlay\nadless\nadlet\nAdlumi
a\nadlumidine\nadlumine\nadman\nadmarginate\nadmaxillary\nadmeasure\nadmeasureme
nt\nadmeasurer\nadmedial\nadmedian\nadmensuration\nadmi\nadminicle\nadminicula\n
adminicular\nadminiculary\nadminiculate\nadminiculation\nadminiculum\nadminister
\nadministerd\nadministerial\nadministrable\nadministrant\nadministrate\nadminis
tration\nadministrational\nadministrative\nadministratively\nadministrator\nadmi
nistratorship\nadministratress\nadministratrices\nadministratrix\nadmirability\n

[21]:
```
words = data.split('\n')
print('There are {0} words in the file.'.format(len(words)))
```

ly\nadmissibility\nadmissible\nadmissibleness\nadmissibly\nadmission\nadmissive\
nadmissory\nadmit\nadmittable\nadmittance\nadmitted\nadmittedly\nadmittee\nadmit
ter\nadmittible\nadmix\nadmixtion\nadmixture\nadmonish\nadmonisher\nadmonishingl

There are 235887 words in the file.

[22]:
```
data.find('needle')
```

ly\nadmonitor\nadmonitorial\nadmonitorily\nadmonitory\nadmonitrix\nadmortization
\nadnascence\nadnascent\nadnate\nadnation\nadnephrine\nadnerval\nadneural\nadnex
\nadnexal\nadnexed\nadnexitis\nadnexopexy\nadnominal\nadnominally\nadnomination\

[22]: 831052

[23]:
```
data[831052:831052+6]
```

y\nAdolph\nAdolphus\nAdonai\nAdonean\nAdonia\nAdoniad\nAdonian\nAdonic\nadonidin
\nAdonin\nAdoniram\nAdonis\nadonite\nadonitol\nadonize\nadoperate\nadoperation\n
adopt\nadoptability\nadoptable\nadoptant\nadoptative\nadopted\nadoptedly\nadopte

[23]: 'needle'

[24]:
```
# let's print first 10 words
print(words[:10])
```

ness\nadorably\nadoral\nadorally\nadorant\nAdorantes\nadoration\nadoratory\nador
er\nadore\nAdoretus\nadoringly\nadorn\nadornedly\nadornment\nadosculat
ion\nadossed\nadoulie\nadown\nAdoxa\nAdoxaceae\nadoxaceous\nadoxography\nadoxy\n

['A', 'a', 'aa', 'aal', 'aalii', 'aam', 'Aani', 'aardvark', 'aardwolf', 'Aaron']

[25]:
```
help(list)
```

nAdrammelech\nadread\nadream\nadreamed\nadreamt\nadrectal\nadrenal\nadrenalectom
ize\nadrenalectomy\nAdrenalin\nadrenaline\nadrenalize\nadrenalone\nadrenergic\na
drenin\nadrenine\nadrenochrome\nadrenocortical\nadrenocorticotropic\nadrenolysis
\nadrenolytic\nadrenotropic\nAdrian\nAdriana\nAdriatic\nAdrienne\nadrift\nadrip\
nadroit\nadroitly\nadroitness\nadroop\nadrop\nadrostral\nadrowse\nadrue\nadry\na
dsbud\nadscendent\nadscititious\nadscititiously\nadscript\nadscripted\nadscripti

```
Help on class list in module builtins:

class list(object)
 |  list(iterable=(), /)
 |
 |  Built-in mutable sequence.
 |
 |  If no argument is given, the constructor creates a new empty list.
 |  The argument must be an iterable if specified.
 |
 |  Methods defined here:
 |
 |  __add__(self, value, /)
 |      Return self+value.
 |
 |  __contains__(self, key, /)
 |      Return key in self.
 |
 |  __delitem__(self, key, /)
 |      Delete self[key].
 |
 |  __eq__(self, value, /)
 |      Return self==value.
 |
 |  __ge__(self, value, /)
 |      Return self>=value.
 |
 |  __getattribute__(self, name, /)
 |      Return getattr(self, name).
 |
 |  __getitem__(…)
 |      x.__getitem__(y) <==> x[y]
 |
 |  __gt__(self, value, /)
 |      Return self>value.
 |
 |  __iadd__(self, value, /)
 |      Implement self+=value.
 |
 |  __imul__(self, value, /)
 |      Implement self*=value.
 |
 |  __init__(self, /, *args, **kwargs)
 |      Initialize self.  See help(type(self)) for accurate signature.
 |
 |  __iter__(self, /)
 |      Implement iter(self).
 |
```

```
|  __le__(self, value, /)
|      Return self<=value.
|
|  __len__(self, /)
|      Return len(self).
|
|  __lt__(self, value, /)
|      Return self<value.
|
|  __mul__(self, value, /)
|      Return self*value.
|
|  __ne__(self, value, /)
|      Return self!=value.
|
|  __repr__(self, /)
|      Return repr(self).
|
|  __reversed__(self, /)
|      Return a reverse iterator over the list.
|
|  __rmul__(self, value, /)
|      Return value*self.
|
|  __setitem__(self, key, value, /)
|      Set self[key] to value.
|
|  __sizeof__(self, /)
|      Return the size of the list in memory, in bytes.
|
|  append(self, object, /)
|      Append object to the end of the list.
|
|  clear(self, /)
|      Remove all items from list.
|
|  copy(self, /)
|      Return a shallow copy of the list.
|
|  count(self, value, /)
|      Return number of occurrences of value.
|
|  extend(self, iterable, /)
|      Extend list by appending elements from the iterable.
|
|  index(self, value, start=0, stop=9223372036854775807, /)
|      Return first index of value.
|
```

```
|      Raises ValueError if the value is not present.
|
|  insert(self, index, object, /)
|      Insert object before index.
|
|  pop(self, index=-1, /)
|      Remove and return item at index (default last).
|
|      Raises IndexError if list is empty or index is out of range.
|
|  remove(self, value, /)
|      Remove first occurrence of value.
|
|      Raises ValueError if the value is not present.
|
|  reverse(self, /)
|      Reverse *IN PLACE*.
|
|  sort(self, /, *, key=None, reverse=False)
|      Stable sort *IN PLACE*.
|
|  ----------------------------------------------------------------------
|  Static methods defined here:
|
|  __new__(*args, **kwargs) from builtins.type
|      Create and return a new object.  See help(type) for accurate signature.
|
|  ----------------------------------------------------------------------
|  Data and other attributes defined here:
|
|  __hash__ = None
```

[26]:
```
words.index('needle')
```

[26]: 123097

[27]:
```
words[123097]
```

[27]: 'needle'

1.5 reading the whole file as list of lines

[28]:
```
file = '/usr/share/dict/words'
with open(file) as f:
    lines = f.readlines()
```

```
print('There are {0} words in the file.'.format(len(data)))
```

```
There are 2493109 words in the file.
```

[29]:
```
lines[:2]
```

[29]:
```
['A\n', 'a\n']
```

[30]:
```
for word in lines[:10]:
    print(word.strip())
```

```
A
a
aa
aal
aalii
aam
Aani
aardvark
aardwolf
Aaron
```

[31]:
```
for word in lines[len(lines)-10:]:
    print(word.strip())
```

```
zymotoxic
zymurgy
Zyrenian
Zyrian
Zyryan
zythem
Zythia
zythum
Zyzomys
Zyzzogeton
```

1.6 select a random word from list of words

- import random
- random.choice(wordList)

[32]:
```
import random
word = random.choice(lines)
word = word.lower()
print(f'random word = {word}')
```

```
random word = multisegmentate
```

1.7 exercises

1. Write a program that reads a file and writes out a new file with the lines in reversed order (i.e. the first line in the old file becomes the last one in the new file.)
2. Write a program that reads a file and prints only those lines that contain the substring snake.
3. Write a program that reads a text file and produces an output file which is a copy of the file, except the first five columns of each line contain a four digit line number, followed by a space. Start numbering the first line in the output file at 1. Ensure that every line number is formatted to the same width in the output file. Use one of your Python programs as test data for this exercise: your output should be a printed and numbered listing of the Python program.
4. Write a program that undoes the numbering of the previous exercise: it should read a file with numbered lines and produce another file without line numbers.

[ ]: