

2024 01January 01

January 3, 2024

1 Agenda

- Generator functions
- Generator comprehensions
- Concurrency
 - Threads
 - Multiprocessing
 - asyncio

```
[1]: def myfunc(x, y):  
      for one_number in range(x, y):  
          yield one_number
```

```
[ ]:
```

```
[2]: myfunc(10, 20)
```

```
[2]: <generator object myfunc at 0x10ce49700>
```

```
[3]: for one_item in myfunc(10, 20):  
      print(one_item)
```

```
10  
11  
12  
13  
14  
15  
16  
17  
18  
19
```

```
[4]: def evenrange(start, finish):  
      for one_number in range(start, finish):  
          if one_number % 2:  
              continue  
          yield one_number
```

```
[ ]:
```

```
[5]: for one_item in evenrange(10, 20):  
      print(one_item)
```

```
10  
12  
14  
16  
18
```

2 Things to remember about generators

- `yield` means: return the value (in the iteration/loop), and go to sleep right after
- if we use `return` without an argument, we effectively raise `StopIteration`
- Also when the function exits normally/naturally, we effectively raise `StopIteration`
- Don't raise `StopIteration` in a generator function! Let the system do it for you
- Local variables retain their values between invocations of `yield`

```
[6]: def myfunc():  
      return f'Hello, world!'
```

```
[7]: def mygen():  
      yield f'Hello, world!'
```

```
[9]: myfunc()
```

```
[9]: 'Hello, world!'
```

```
[10]: mygen()
```

```
[10]: <generator object mygen at 0x10cebfd70>
```

```
[11]: type(myfunc)
```

```
[11]: function
```

```
[12]: type(mygen)
```

```
[12]: function
```

```
[13]: myfunc.__code__.co_consts
```

```
[13]: (None, 'Hello, world!')
```

```
[14]: myfunc.__code__.co_flags
```

```
[14]: 3
```

```
[16]: bin(myfunc.__code__.co_flags)
```

```
[16]: '0b11'
```

```
[17]: bin(mygen.__code__.co_flags)
```

```
[17]: '0b100011'
```

```
[18]: import dis
```

```
[19]: dis.show_code(myfunc)
```

```
Name:          myfunc
Filename:
/var/folders/rr/0mnyyv811fs5vyp22gf4fxk00000gn/T/ipykernel_76740/2896535200.py
Argument count: 0
Positional-only arguments: 0
Kw-only arguments: 0
Number of locals: 0
Stack size:    1
Flags:         OPTIMIZED, NEWLOCALS
Constants:
  0: None
  1: 'Hello, world!'
```

```
[20]: dis.show_code(mygen)
```

```
Name:          mygen
Filename:
/var/folders/rr/0mnyyv811fs5vyp22gf4fxk00000gn/T/ipykernel_76740/3368138942.py
Argument count: 0
Positional-only arguments: 0
Kw-only arguments: 0
Number of locals: 0
Stack size:    1
Flags:         OPTIMIZED, NEWLOCALS, GENERATOR
Constants:
  0: None
  1: 'Hello, world!'
```

```
[21]: def myfunc():
      return 1
      return 2
      return 3
```

```
[22]: dis.dis(myfunc)
```

```
1          0 RESUME          0
```

```
2          2 LOAD_CONST          1 (1)
          4 RETURN_VALUE
```

```
[23]: def myfunc():
      if False:
          yield 'Hello'
```

```
[24]: dis.show_code(myfunc)
```

```
Name:          myfunc
Filename:
/var/folders/rr/0mnyyv811fs5vyp22gf4fxk00000gn/T/ipykernel_76740/1059155119.py
Argument count: 0
Positional-only arguments: 0
Kw-only arguments: 0
Number of locals: 0
Stack size:    1
Flags:         OPTIMIZED, NEWLOCALS, GENERATOR
Constants:
  0: None
```

```
[25]: g1 = evenrange(10, 20)
      g2 = evenrange(10, 20)
      g3 = evenrange(10, 20)
```

```
[26]: next(g1)
```

```
[26]: 10
```

```
[27]: next(g1)
```

```
[27]: 12
```

```
[28]: next(g1)
```

```
[28]: 14
```

```
[29]: g1.gi_frame.f_lineno
```

```
[29]: 5
```

```
[30]: g2.gi_frame.f_lineno
```

```
[30]: 1
```

3 Exercise: read_n

When we iterate over a file, each iteration gives us the next line, up to and including `\n`. Sometimes, though, we want to read a file in chunks of 2, 5, or 10 lines.

1. Write `read_n`, that takes two arguments:
 - The name of a file
 - The number of lines we want to get back in each iteration
2. With each iteration, we should get that number of lines back, as a single string.
3. The final iteration can give us fewer lines.

Example:

```
for one_chunk in read_n('/etc/passwd', 5):
    print(one_chunk)
```

```
[31]: def read_n(filename, n):
      with open(filename) as f:
          while True:
              output = f.readline()

              if output:
                  yield output
              else:
                  return
```

```
[32]: for one_chunk in read_n('/etc/passwd', 5):
      print(one_chunk)
```

```
##
```

```
# User Database
```

```
#
```

```
# Note that this file is consulted directly only when the system is running
```

```
# in single-user mode.  At other times this information is provided by
```

```
# Open Directory.
```

```
#
```

```
# See the opendirectoryd(8) man page for additional information about
```

```
# Open Directory.
```

```
##
```

```
nobody:*:-2:-2:Unprivileged User:/var/empty:/usr/bin/false
```

root:*:0:0:System Administrator:/var/root:/bin/sh

daemon:*:1:1:System Services:/var/root:/usr/bin/false

_uucp:*:4:4:Unix to Unix Copy Protocol:/var/spool/uucp:/usr/sbin/uucico

_taskgated:*:13:13:Task Gate Daemon:/var/empty:/usr/bin/false

_networkd:*:24:24:Network Services:/var/networkd:/usr/bin/false

_installassistant:*:25:25:Install Assistant:/var/empty:/usr/bin/false

_lp:*:26:26:Printing Services:/var/spool/cups:/usr/bin/false

_postfix:*:27:27:Postfix Mail Server:/var/spool/postfix:/usr/bin/false

_scsd:*:31:31:Service Configuration Service:/var/empty:/usr/bin/false

_ces:*:32:32:Certificate Enrollment Service:/var/empty:/usr/bin/false

_appstore:*:33:33:Mac App Store Service:/var/db/appstore:/usr/bin/false

_mcxalr:*:54:54:MCX AppLaunch:/var/empty:/usr/bin/false

_appleevents:*:55:55:AppleEvents Daemon:/var/empty:/usr/bin/false

_geod:*:56:56:Geo Services Daemon:/var/db/geod:/usr/bin/false

_devdocs:*:59:59:Developer Documentation:/var/empty:/usr/bin/false

_sandbox:*:60:60:Seatbelt:/var/empty:/usr/bin/false

_mdnsresponder:*:65:65:mDNSResponder:/var/empty:/usr/bin/false

_ard:*:67:67:Apple Remote Desktop:/var/empty:/usr/bin/false

_www:*:70:70:World Wide Web Server:/Library/WebServer:/usr/bin/false

_eppc:*:71:71:Apple Events User:/var/empty:/usr/bin/false

_cvs:*:72:72:CVS Server:/var/empty:/usr/bin/false

_svn:*:73:73:SVN Server:/var/empty:/usr/bin/false

_mysql:*:74:74:MySQL Server:/var/empty:/usr/bin/false

_sshd:*:75:75:sshd Privilege separation:/var/empty:/usr/bin/false

_qtss:*:76:76:QuickTime Streaming Server:/var/empty:/usr/bin/false
 _cyrus:*:77:6:Cyrus Administrator:/var/imap:/usr/bin/false
 _mailman:*:78:78:Mailman List Server:/var/empty:/usr/bin/false
 _appserver:*:79:79:Application Server:/var/empty:/usr/bin/false
 _clamav:*:82:82:ClamAV Daemon:/var/virusmails:/usr/bin/false
 _amavisd:*:83:83:AMaViS Daemon:/var/virusmails:/usr/bin/false
 _jabber:*:84:84:Jabber XMPP Server:/var/empty:/usr/bin/false
 _appowner:*:87:87:Application Owner:/var/empty:/usr/bin/false
 _windowserver:*:88:88:WindowServer:/var/empty:/usr/bin/false
 _spotlight:*:89:89:Spotlight:/var/empty:/usr/bin/false
 _tokend:*:91:91:Token Daemon:/var/empty:/usr/bin/false
 _securityagent:*:92:92:SecurityAgent:/var/db/securityagent:/usr/bin/false
 _calendar:*:93:93:Calendar:/var/empty:/usr/bin/false
 _teamsserver:*:94:94:TeamsServer:/var/teamsserver:/usr/bin/false
 _update_sharing:*:95:-2:Update Sharing:/var/empty:/usr/bin/false
 _installer:*:96:-2:Installer:/var/empty:/usr/bin/false
 _atsserver:*:97:97:ATS Server:/var/empty:/usr/bin/false
 _ftp:*:98:-2:FTP Daemon:/var/empty:/usr/bin/false
 _unknown:*:99:99:Unknown User:/var/empty:/usr/bin/false
 _softwareupdate:*:200:200:Software Update
 Service:/var/db/softwareupdate:/usr/bin/false
 _coreaudiod:*:202:202:Core Audio Daemon:/var/empty:/usr/bin/false
 _screensaver:*:203:203:Screensaver:/var/empty:/usr/bin/false
 _locationd:*:205:205:Location Daemon:/var/db/locationd:/usr/bin/false

_trustevaluationagent:*:208:208:Trust Evaluation Agent:/var/empty:/usr/bin/false
 _timezone:*:210:210:AutoTimeZoneDaemon:/var/empty:/usr/bin/false
 _lda:*:211:211:Local Delivery Agent:/var/empty:/usr/bin/false
 _cvmsroot:*:212:212:CVMS Root:/var/empty:/usr/bin/false
 _usbmuxd:*:213:213:iPhone OS Device Helper:/var/db/lockdown:/usr/bin/false
 _dovecot:*:214:6:Dovecot Administrator:/var/empty:/usr/bin/false
 _dpaudio:*:215:215:DP Audio:/var/empty:/usr/bin/false
 _postgres:*:216:216:PostgreSQL Server:/var/empty:/usr/bin/false
 _krbtgt:*:217:-2:Kerberos Ticket Granting Ticket:/var/empty:/usr/bin/false
 _kadmin_admin:*:218:-2:Kerberos Admin Service:/var/empty:/usr/bin/false
 _kadmin_changepw:*:219:-2:Kerberos Change Password
 Service:/var/empty:/usr/bin/false
 _devicemgr:*:220:220:Device Management Server:/var/empty:/usr/bin/false
 _webauthserver:*:221:221:Web Auth Server:/var/empty:/usr/bin/false
 _netbios:*:222:222:NetBIOS:/var/empty:/usr/bin/false
 _warmd:*:224:224:Warm Daemon:/var/empty:/usr/bin/false
 _dovenull:*:227:227:Dovecot Authentication:/var/empty:/usr/bin/false
 _netstatistics:*:228:228:Network Statistics Daemon:/var/empty:/usr/bin/false
 _avbdeviced:*:229:-2:Ethernet AVB Device Daemon:/var/empty:/usr/bin/false
 _krb_krbtgt:*:230:-2:Open Directory Kerberos Ticket Granting
 Ticket:/var/empty:/usr/bin/false
 _krb_kadmin:*:231:-2:Open Directory Kerberos Admin
 Service:/var/empty:/usr/bin/false
 _krb_changepw:*:232:-2:Open Directory Kerberos Change Password
 Service:/var/empty:/usr/bin/false
 _krb_kerberos:*:233:-2:Open Directory Kerberos:/var/empty:/usr/bin/false

_krb_anonymous:*:234:-2:Open Directory Kerberos
 Anonymous:/var/empty:/usr/bin/false

_assetcache:*:235:235:Asset Cache Service:/var/empty:/usr/bin/false

_coremediaiod:*:236:236:Core Media IO Daemon:/var/empty:/usr/bin/false

_launchservicesd:*:239:239:_launchservicesd:/var/empty:/usr/bin/false

_iconservices:*:240:240:IconServices:/var/empty:/usr/bin/false

_distnote:*:241:241:DistNote:/var/empty:/usr/bin/false

_nsurlsessiond:*:242:242:NSURLSession
 Daemon:/var/db/nsurlsessiond:/usr/bin/false

_displaypolicyd:*:244:244:Display Policy Daemon:/var/empty:/usr/bin/false

_astris:*:245:245:Astris Services:/var/db/astris:/usr/bin/false

_krbfast:*:246:-2:Kerberos FAST Account:/var/empty:/usr/bin/false

_gamecontrollerd:*:247:247:Game Controller Daemon:/var/empty:/usr/bin/false

_mbsetupuser:*:248:248:Setup User:/var/setup:/bin/bash

_ondemand:*:249:249:On Demand Resource Daemon:/var/db/ondemand:/usr/bin/false

_xserverdocs:*:251:251:macOS Server Documents Service:/var/empty:/usr/bin/false

_wwwproxy:*:252:252:WWW Proxy:/var/empty:/usr/bin/false

_mobileasset:*:253:253:MobileAsset User:/var/ma:/usr/bin/false

_findmydevice:*:254:254:Find My Device
 Daemon:/var/db/findmydevice:/usr/bin/false

_datadetectors:*:257:257:DataDetectors:/var/db/datadetectors:/usr/bin/false

_captiveagent:*:258:258:captiveagent:/var/empty:/usr/bin/false

_ctkd:*:259:259:ctkd Account:/var/empty:/usr/bin/false

_applepay:*:260:260:applepay Account:/var/db/applepay:/usr/bin/false

_hidd:*:261:261:HID Service User:/var/db/hidd:/usr/bin/false

_cmiodalassistants:*:262:262:CoreMedia IO Assistants

User:/var/db/cmiodalassistants:/usr/bin/false
 _analyticsd*:263:263:Analytics Daemon:/var/db/analyticsd:/usr/bin/false
 _fpsd*:265:265:FPS Daemon:/var/db/fpsd:/usr/bin/false
 _timed*:266:266:Time Sync Daemon:/var/db/timed:/usr/bin/false
 _nearbyd*:268:268:Proximity and Ranging Daemon:/var/db/nearbyd:/usr/bin/false
 _reportmemoryexception*:269:269:ReportMemoryException:/var/db/reportmemoryexception:/usr/bin/false
 _driverkit*:270:270:DriverKit:/var/empty:/usr/bin/false
 _diskimagesiod*:271:271:DiskImages IO
 Daemon:/var/db/diskimagesiod:/usr/bin/false
 _logd*:272:272:Log Daemon:/var/db/diagnostics:/usr/bin/false
 _appinstalld*:273:273:App Install Daemon:/var/db/appinstalld:/usr/bin/false
 _installcoordinationd*:274:274:Install Coordination
 Daemon:/var/db/installcoordinationd:/usr/bin/false
 _demod*:275:275:Demo Daemon:/var/empty:/usr/bin/false
 _rmd*:277:277:Remote Management Daemon:/var/db/rmd:/usr/bin/false
 _accessoryupdater*:278:278:Accessory Update
 Daemon:/var/db/accessoryupdater:/usr/bin/false
 _knowledgegraphd*:279:279:Knowledge Graph
 Daemon:/var/db/knowledgegraphd:/usr/bin/false
 _coreml*:280:280:CoreML Services:/var/db/coreml:/usr/bin/false
 _sntpd*:281:281:SNTP Server Daemon:/var/empty:/usr/bin/false
 _trustd*:282:282:trustd:/var/empty:/usr/bin/false
 _mmaintenanced*:283:283:mmaintenanced:/var/db/mmaintenanced:/usr/bin/false
 _darwind daemon*:284:284:Darwin Daemon:/var/db/darwind daemon:/usr/bin/false
 _notification_proxy*:285:285:Notification Proxy:/var/empty:/usr/bin/false
 _avphidbridge*:288:288:Apple Virtual Platform HID

```

Bridge:/var/empty:/usr/bin/false

_biome*:289:289:Biome:/var/db/biome:/usr/bin/false

_backgroundassets*:291:291:Background Assets Service:/var/empty:/usr/bin/false

_mobilegestalthelper*:293:293:MobileGestaltHelper:/var/empty:/usr/bin/false

_audiomxd*:294:294:Audio and MediaExperience
Daemon:/var/db/audiomxd:/usr/bin/false

_terminusd*:295:295:Terminus:/var/empty:/usr/bin/false

_neuralengine*:296:296:AppleNeuralEngine:/var/db/neuralengine:/usr/bin/false

_oahd*:441:441:OAH Daemon:/var/empty:/usr/bin/false

```

```

[33]: # let's take n into account

def read_n(filename, n):
    with open(filename) as f:
        while True:
            output_lines = []

            for i in range(n):
                output_lines.append(f.readline())

            output = ''.join(output_lines)

            if output:
                yield output
            else:
                return

```

```

[34]: for one_chunk in read_n('/etc/passwd', 5):
        print(one_chunk)

```

```

##
# User Database
#
# Note that this file is consulted directly only when the system is running
# in single-user mode.  At other times this information is provided by

# Open Directory.
#
# See the opendirectoryd(8) man page for additional information about
# Open Directory.

```

##

```
nobody:*:-2:-2:Unprivileged User:/var/empty:/usr/bin/false
root:*:0:0:System Administrator:/var/root:/bin/sh
daemon:*:1:1:System Services:/var/root:/usr/bin/false
_uucp:*:4:4:Unix to Unix Copy Protocol:/var/spool/uucp:/usr/sbin/uucico
_taskgated:*:13:13:Task Gate Daemon:/var/empty:/usr/bin/false

_networkd:*:24:24:Network Services:/var/networkd:/usr/bin/false
_installassistant:*:25:25:Install Assistant:/var/empty:/usr/bin/false
_lp:*:26:26:Printing Services:/var/spool/cups:/usr/bin/false
_postfix:*:27:27:Postfix Mail Server:/var/spool/postfix:/usr/bin/false
_scsd:*:31:31:Service Configuration Service:/var/empty:/usr/bin/false

_ces:*:32:32:Certificate Enrollment Service:/var/empty:/usr/bin/false
_appstore:*:33:33:Mac App Store Service:/var/db/appstore:/usr/bin/false
_mcxalr:*:54:54:MCX AppLaunch:/var/empty:/usr/bin/false
_appleevents:*:55:55:AppleEvents Daemon:/var/empty:/usr/bin/false
_geod:*:56:56:Geo Services Daemon:/var/db/geod:/usr/bin/false

_devdocs:*:59:59:Developer Documentation:/var/empty:/usr/bin/false
_sandbox:*:60:60:Seatbelt:/var/empty:/usr/bin/false
_mdnsresponder:*:65:65:mDNSResponder:/var/empty:/usr/bin/false
_ard:*:67:67:Apple Remote Desktop:/var/empty:/usr/bin/false
_www:*:70:70:World Wide Web Server:/Library/WebServer:/usr/bin/false

_eppc:*:71:71:Apple Events User:/var/empty:/usr/bin/false
_cvs:*:72:72:CVS Server:/var/empty:/usr/bin/false
_svn:*:73:73:SVN Server:/var/empty:/usr/bin/false
_mysql:*:74:74:MySQL Server:/var/empty:/usr/bin/false
_sshd:*:75:75:sshd Privilege separation:/var/empty:/usr/bin/false

_qtss:*:76:76:QuickTime Streaming Server:/var/empty:/usr/bin/false
_cyrus:*:77:6:Cyrus Administrator:/var/imap:/usr/bin/false
_mailman:*:78:78:Mailman List Server:/var/empty:/usr/bin/false
_appserver:*:79:79:Application Server:/var/empty:/usr/bin/false
_clamav:*:82:82:ClamAV Daemon:/var/virusmails:/usr/bin/false

_amavisd:*:83:83:AMaViS Daemon:/var/virusmails:/usr/bin/false
_jabber:*:84:84:Jabber XMPP Server:/var/empty:/usr/bin/false
_appowner:*:87:87:Application Owner:/var/empty:/usr/bin/false
_windowserver:*:88:88:WindowServer:/var/empty:/usr/bin/false
_spotlight:*:89:89:Spotlight:/var/empty:/usr/bin/false

_tokend:*:91:91:Token Daemon:/var/empty:/usr/bin/false
_securityagent:*:92:92:SecurityAgent:/var/db/securityagent:/usr/bin/false
_calendar:*:93:93:Calendar:/var/empty:/usr/bin/false
_teamsserver:*:94:94:TeamsServer:/var/teamsserver:/usr/bin/false
```

```

_update_sharing*:95:-2:Update Sharing:/var/empty:/usr/bin/false

_installer*:96:-2:Installer:/var/empty:/usr/bin/false
_atsserver*:97:97:ATS Server:/var/empty:/usr/bin/false
_ftp*:98:-2:FTP Daemon:/var/empty:/usr/bin/false
_unknown*:99:99:Unknown User:/var/empty:/usr/bin/false
_softwareupdate*:200:200:Software Update
Service:/var/db/softwareupdate:/usr/bin/false

_coreaudiod*:202:202:Core Audio Daemon:/var/empty:/usr/bin/false
_screensaver*:203:203:Screensaver:/var/empty:/usr/bin/false
_locationd*:205:205:Location Daemon:/var/db/locationd:/usr/bin/false
_trustevaluationagent*:208:208:Trust Evaluation Agent:/var/empty:/usr/bin/false
_timezone*:210:210:AutoTimeZoneDaemon:/var/empty:/usr/bin/false

_lda*:211:211:Local Delivery Agent:/var/empty:/usr/bin/false
_cvmsroot*:212:212:CVMS Root:/var/empty:/usr/bin/false
_usbmuxd*:213:213:iPhone OS Device Helper:/var/db/lockdown:/usr/bin/false
_dovecot*:214:6:Dovecot Administrator:/var/empty:/usr/bin/false
_dpauld*:215:215:DP Audio:/var/empty:/usr/bin/false

_postgres*:216:216:PostgreSQL Server:/var/empty:/usr/bin/false
_krbtgt*:217:-2:Kerberos Ticket Granting Ticket:/var/empty:/usr/bin/false
_kadmin_admin*:218:-2:Kerberos Admin Service:/var/empty:/usr/bin/false
_kadmin_changepw*:219:-2:Kerberos Change Password
Service:/var/empty:/usr/bin/false
_devicemgr*:220:220:Device Management Server:/var/empty:/usr/bin/false

_webauthserver*:221:221:Web Auth Server:/var/empty:/usr/bin/false
_netbios*:222:222:NetBIOS:/var/empty:/usr/bin/false
_warmd*:224:224:Warm Daemon:/var/empty:/usr/bin/false
_dovenull*:227:227:Dovecot Authentication:/var/empty:/usr/bin/false
_netstatistics*:228:228:Network Statistics Daemon:/var/empty:/usr/bin/false

_avbdeviced*:229:-2:Ethernet AVB Device Daemon:/var/empty:/usr/bin/false
_krb_krbtgt*:230:-2:Open Directory Kerberos Ticket Granting
Ticket:/var/empty:/usr/bin/false
_krb_kadmin*:231:-2:Open Directory Kerberos Admin
Service:/var/empty:/usr/bin/false
_krb_changepw*:232:-2:Open Directory Kerberos Change Password
Service:/var/empty:/usr/bin/false
_krb_kerberos*:233:-2:Open Directory Kerberos:/var/empty:/usr/bin/false

_krb_anonymous*:234:-2:Open Directory Kerberos
Anonymous:/var/empty:/usr/bin/false
_assetcache*:235:235:Asset Cache Service:/var/empty:/usr/bin/false
_coremediaiod*:236:236:Core Media IO Daemon:/var/empty:/usr/bin/false
_launchservicesd*:239:239:_launchservicesd:/var/empty:/usr/bin/false

```

```

_iconservices:*:240:240:IconServices:/var/empty:/usr/bin/false

_distnote:*:241:241:DistNote:/var/empty:/usr/bin/false
_nsurlsessiond:*:242:242:NSURLSession
Daemon:/var/db/nsurlsessiond:/usr/bin/false
_displaypolicyd:*:244:244:Display Policy Daemon:/var/empty:/usr/bin/false
_astris:*:245:245:Astris Services:/var/db/astris:/usr/bin/false
_krbfast:*:246:-2:Kerberos FAST Account:/var/empty:/usr/bin/false

_gamecontrollerd:*:247:247:Game Controller Daemon:/var/empty:/usr/bin/false
_mbsetupuser:*:248:248:Setup User:/var/setup:/bin/bash
_ondemand:*:249:249:On Demand Resource Daemon:/var/db/ondemand:/usr/bin/false
_xserverdocs:*:251:251:macOS Server Documents Service:/var/empty:/usr/bin/false
_wwwproxy:*:252:252:WWW Proxy:/var/empty:/usr/bin/false

_mobileasset:*:253:253:MobileAsset User:/var/ma:/usr/bin/false
_findmydevice:*:254:254:Find My Device
Daemon:/var/db/findmydevice:/usr/bin/false
_datadetectors:*:257:257:DataDetectors:/var/db/datadetectors:/usr/bin/false
_captiveagent:*:258:258:captiveagent:/var/empty:/usr/bin/false
_ctkd:*:259:259:ctkd Account:/var/empty:/usr/bin/false

_applepay:*:260:260:applepay Account:/var/db/applepay:/usr/bin/false
_hidd:*:261:261:HID Service User:/var/db/hidd:/usr/bin/false
_cmiodalassistants:*:262:262:CoreMedia IO Assistants
User:/var/db/cmiodalassistants:/usr/bin/false
_analyticisd:*:263:263:Analytics Daemon:/var/db/analyticisd:/usr/bin/false
_fpsd:*:265:265:FPS Daemon:/var/db/fpsd:/usr/bin/false

_timed:*:266:266:Time Sync Daemon:/var/db/timed:/usr/bin/false
_nearbyd:*:268:268:Proximity and Ranging Daemon:/var/db/nearbyd:/usr/bin/false
_reportmemoryexception:*:269:269:ReportMemoryException:/var/db/reportmemoryexcep
tion:/usr/bin/false
_driverkit:*:270:270:DriverKit:/var/empty:/usr/bin/false
_diskimagesiod:*:271:271:DiskImages IO
Daemon:/var/db/diskimagesiod:/usr/bin/false

_logd:*:272:272:Log Daemon:/var/db/diagnostics:/usr/bin/false
_appinstalld:*:273:273:App Install Daemon:/var/db/appinstalld:/usr/bin/false
_installcoordinationd:*:274:274:Install Coordination
Daemon:/var/db/installcoordinationd:/usr/bin/false
_demod:*:275:275:Demo Daemon:/var/empty:/usr/bin/false
_rmd:*:277:277:Remote Management Daemon:/var/db/rmd:/usr/bin/false

_accessoryupdater:*:278:278:Accessory Update
Daemon:/var/db/accessoryupdater:/usr/bin/false
_knowledgegraphd:*:279:279:Knowledge Graph
Daemon:/var/db/knowledgegraphd:/usr/bin/false

```

```

_coreml*:280:280:CoreML Services:/var/db/coreml:/usr/bin/false
_sntpd*:281:281:SNTP Server Daemon:/var/empty:/usr/bin/false
_trustd*:282:282:trustd:/var/empty:/usr/bin/false

_mmaintenanced*:283:283:mmaintenanced:/var/db/mmaintenanced:/usr/bin/false
_darwind daemon*:284:284:Darwin Daemon:/var/db/darwind daemon:/usr/bin/false
_notification_proxy*:285:285:Notification Proxy:/var/empty:/usr/bin/false
_avphidbridge*:288:288:Apple Virtual Platform HID
Bridge:/var/empty:/usr/bin/false
_biome*:289:289:Biome:/var/db/biome:/usr/bin/false

_backgroundassets*:291:291:Background Assets Service:/var/empty:/usr/bin/false
_mobilegestalt helper*:293:293:MobileGestaltHelper:/var/empty:/usr/bin/false
_audiomxd*:294:294:Audio and MediaExperience
Daemon:/var/db/audiomxd:/usr/bin/false
_terminusd*:295:295:Terminus:/var/empty:/usr/bin/false
_neuralengine*:296:296:AppleNeuralEngine:/var/db/neuralengine:/usr/bin/false

_oahd*:441:441:OAH Daemon:/var/empty:/usr/bin/false

```

[35]: *# let's take n into account*

```

def read_n(filename, n):
    with open(filename) as f:
        while True:
            output = ''.join([f.readline()
                               for i in range(n)])

            if output:
                yield output
            else:
                return

for one_chunk in read_n('/etc/passwd', 7):
    print(one_chunk)

```

```

##
# User Database
#
# Note that this file is consulted directly only when the system is running
# in single-user mode. At other times this information is provided by
# Open Directory.
#
# See the opendirectoryd(8) man page for additional information about
# Open Directory.
##

```

```

nobody:*:-2:-2:Unprivileged User:/var/empty:/usr/bin/false
root:*:0:0:System Administrator:/var/root:/bin/sh
daemon:*:1:1:System Services:/var/root:/usr/bin/false
_uucp:*:4:4:Unix to Unix Copy Protocol:/var/spool/uucp:/usr/sbin/uucico

_taskgated:*:13:13:Task Gate Daemon:/var/empty:/usr/bin/false
_networkd:*:24:24:Network Services:/var/networkd:/usr/bin/false
_installassistant:*:25:25:Install Assistant:/var/empty:/usr/bin/false
_lp:*:26:26:Printing Services:/var/spool/cups:/usr/bin/false
_postfix:*:27:27:Postfix Mail Server:/var/spool/postfix:/usr/bin/false
_scsd:*:31:31:Service Configuration Service:/var/empty:/usr/bin/false
_ces:*:32:32:Certificate Enrollment Service:/var/empty:/usr/bin/false

_appstore:*:33:33:Mac App Store Service:/var/db/appstore:/usr/bin/false
_mcxalr:*:54:54:MCX AppLaunch:/var/empty:/usr/bin/false
_appleevents:*:55:55:AppleEvents Daemon:/var/empty:/usr/bin/false
_geod:*:56:56:Geo Services Daemon:/var/db/geod:/usr/bin/false
_devdocs:*:59:59:Developer Documentation:/var/empty:/usr/bin/false
_sandbox:*:60:60:Seatbelt:/var/empty:/usr/bin/false
_mdnsresponder:*:65:65:mDNSResponder:/var/empty:/usr/bin/false

_ard:*:67:67:Apple Remote Desktop:/var/empty:/usr/bin/false
_www:*:70:70:World Wide Web Server:/Library/WebServer:/usr/bin/false
_eppc:*:71:71:Apple Events User:/var/empty:/usr/bin/false
_cvs:*:72:72:CVS Server:/var/empty:/usr/bin/false
_svn:*:73:73:SVN Server:/var/empty:/usr/bin/false
_mysql:*:74:74:MySQL Server:/var/empty:/usr/bin/false
_sshd:*:75:75:sshd Privilege separation:/var/empty:/usr/bin/false

_qtss:*:76:76:QuickTime Streaming Server:/var/empty:/usr/bin/false
_cyrus:*:77:6:Cyrus Administrator:/var/imap:/usr/bin/false
_mailman:*:78:78:Mailman List Server:/var/empty:/usr/bin/false
_appserver:*:79:79:Application Server:/var/empty:/usr/bin/false
_clamav:*:82:82:ClamAV Daemon:/var/virusmails:/usr/bin/false
_amavisd:*:83:83:AMaViS Daemon:/var/virusmails:/usr/bin/false
_jabber:*:84:84:Jabber XMPP Server:/var/empty:/usr/bin/false

_appowner:*:87:87:Application Owner:/var/empty:/usr/bin/false
_windowserver:*:88:88:WindowServer:/var/empty:/usr/bin/false
_spotlight:*:89:89:Spotlight:/var/empty:/usr/bin/false
_tokend:*:91:91:Token Daemon:/var/empty:/usr/bin/false
_securityagent:*:92:92:SecurityAgent:/var/db/securityagent:/usr/bin/false
_calendar:*:93:93:Calendar:/var/empty:/usr/bin/false
_teamsserver:*:94:94:TeamsServer:/var/teamsserver:/usr/bin/false

_update_sharing:*:95:-2:Update Sharing:/var/empty:/usr/bin/false
_installer:*:96:-2:Installer:/var/empty:/usr/bin/false
_atsserver:*:97:97:ATS Server:/var/empty:/usr/bin/false

```



```

_ftp*:98:-2:FTP Daemon:/var/empty:/usr/bin/false
_unknown*:99:99:Unknown User:/var/empty:/usr/bin/false
_softwareupdate*:200:200:Software Update
Service:/var/db/softwareupdate:/usr/bin/false
_coreaudiod*:202:202:Core Audio Daemon:/var/empty:/usr/bin/false

_screensaver*:203:203:Screensaver:/var/empty:/usr/bin/false
_locationd*:205:205:Location Daemon:/var/db/locationd:/usr/bin/false
_trustevaluationagent*:208:208:Trust Evaluation Agent:/var/empty:/usr/bin/false
_timezone*:210:210:AutoTimeZoneDaemon:/var/empty:/usr/bin/false
_lda*:211:211:Local Delivery Agent:/var/empty:/usr/bin/false
_cvmsroot*:212:212:CVMS Root:/var/empty:/usr/bin/false
_usbmuxd*:213:213:iPhone OS Device Helper:/var/db/lockdown:/usr/bin/false

_dovecot*:214:6:Dovecot Administrator:/var/empty:/usr/bin/false
_dpaudio*:215:215:DP Audio:/var/empty:/usr/bin/false
_postgres*:216:216:PostgreSQL Server:/var/empty:/usr/bin/false
_krbtgt*:217:-2:Kerberos Ticket Granting Ticket:/var/empty:/usr/bin/false
_kadmin_admin*:218:-2:Kerberos Admin Service:/var/empty:/usr/bin/false
_kadmin_changepw*:219:-2:Kerberos Change Password
Service:/var/empty:/usr/bin/false
_devicemgr*:220:220:Device Management Server:/var/empty:/usr/bin/false

_webauthserver*:221:221:Web Auth Server:/var/empty:/usr/bin/false
_netbios*:222:222:NetBIOS:/var/empty:/usr/bin/false
_warmd*:224:224:Warm Daemon:/var/empty:/usr/bin/false
_dovenull*:227:227:Dovecot Authentication:/var/empty:/usr/bin/false
_netstatistics*:228:228:Network Statistics Daemon:/var/empty:/usr/bin/false
_avbdeviced*:229:-2:Ethernet AVB Device Daemon:/var/empty:/usr/bin/false
_krb_krbtgt*:230:-2:Open Directory Kerberos Ticket Granting
Ticket:/var/empty:/usr/bin/false

_krb_kadmin*:231:-2:Open Directory Kerberos Admin
Service:/var/empty:/usr/bin/false
_krb_changepw*:232:-2:Open Directory Kerberos Change Password
Service:/var/empty:/usr/bin/false
_krb_kerberos*:233:-2:Open Directory Kerberos:/var/empty:/usr/bin/false
_krb_anonymous*:234:-2:Open Directory Kerberos
Anonymous:/var/empty:/usr/bin/false
_assetcache*:235:235:Asset Cache Service:/var/empty:/usr/bin/false
_coremediaiod*:236:236:Core Media IO Daemon:/var/empty:/usr/bin/false
_launchservicesd*:239:239:_launchservicesd:/var/empty:/usr/bin/false

_iconservices*:240:240:IconServices:/var/empty:/usr/bin/false
_distnote*:241:241:DistNote:/var/empty:/usr/bin/false
_nsurlsessiond*:242:242:NSURLSession
Daemon:/var/db/nsurlsessiond:/usr/bin/false
_displaypolicyd*:244:244:Display Policy Daemon:/var/empty:/usr/bin/false

```

```

_astris:*:245:245:Astris Services:/var/db/astris:/usr/bin/false
_krbfast:*:246:-2:Kerberos FAST Account:/var/empty:/usr/bin/false
_gamecontrollerd:*:247:247:Game Controller Daemon:/var/empty:/usr/bin/false

_mbsetupuser:*:248:248:Setup User:/var/setup:/bin/bash
_ondemand:*:249:249:On Demand Resource Daemon:/var/db/ondemand:/usr/bin/false
_xserverdocs:*:251:251:macOS Server Documents Service:/var/empty:/usr/bin/false
_wwwproxy:*:252:252:WWW Proxy:/var/empty:/usr/bin/false
_mobileasset:*:253:253:MobileAsset User:/var/ma:/usr/bin/false
_findmydevice:*:254:254:Find My Device
Daemon:/var/db/findmydevice:/usr/bin/false
_datadetectors:*:257:257:DataDetectors:/var/db/datadetectors:/usr/bin/false

_captiveagent:*:258:258:captiveagent:/var/empty:/usr/bin/false
_ctkd:*:259:259:ctkd Account:/var/empty:/usr/bin/false
_applepay:*:260:260:applepay Account:/var/db/applepay:/usr/bin/false
_hidd:*:261:261:HID Service User:/var/db/hidd:/usr/bin/false
_cmiodalassistants:*:262:262:CoreMedia IO Assistants
User:/var/db/cmiodalassistants:/usr/bin/false
_analyticsd:*:263:263:Analytics Daemon:/var/db/analyticsd:/usr/bin/false
_fpsd:*:265:265:FPS Daemon:/var/db/fpsd:/usr/bin/false

_timed:*:266:266:Time Sync Daemon:/var/db/timed:/usr/bin/false
_nearbyd:*:268:268:Proximity and Ranging Daemon:/var/db/nearbyd:/usr/bin/false
_reportmemoryexception:*:269:269:ReportMemoryException:/var/db/reportmemoryexcep
tion:/usr/bin/false
_driverkit:*:270:270:DriverKit:/var/empty:/usr/bin/false
_diskimagesiod:*:271:271:DiskImages IO
Daemon:/var/db/diskimagesiod:/usr/bin/false
_logd:*:272:272:Log Daemon:/var/db/diagnostics:/usr/bin/false
_appinstalld:*:273:273:App Install Daemon:/var/db/appinstalld:/usr/bin/false

_installcoordinationd:*:274:274:Install Coordination
Daemon:/var/db/installcoordinationd:/usr/bin/false
_demod:*:275:275:Demo Daemon:/var/empty:/usr/bin/false
_rmd:*:277:277:Remote Management Daemon:/var/db/rmd:/usr/bin/false
_accessoryupdater:*:278:278:Accessory Update
Daemon:/var/db/accessoryupdater:/usr/bin/false
_knowledgegraphd:*:279:279:Knowledge Graph
Daemon:/var/db/knowledgegraphd:/usr/bin/false
_coreml:*:280:280:CoreML Services:/var/db/coreml:/usr/bin/false
_sntpd:*:281:281:SNTP Server Daemon:/var/empty:/usr/bin/false

_trustd:*:282:282:trustd:/var/empty:/usr/bin/false
_mmaintenanced:*:283:283:mmaintenanced:/var/db/mmaintenanced:/usr/bin/false
_darwind daemon:*:284:284:Darwin Daemon:/var/db/darwind daemon:/usr/bin/false
_notification_proxy:*:285:285:Notification Proxy:/var/empty:/usr/bin/false
_avphidbridge:*:288:288:Apple Virtual Platform HID

```

```
Bridge:/var/empty:/usr/bin/false
_biome*:289:289:Biome:/var/db/biome:/usr/bin/false
_backgroundassets*:291:291:Background Assets Service:/var/empty:/usr/bin/false

_mobilegestalthelper*:293:293:MobileGestaltHelper:/var/empty:/usr/bin/false
_audiomxd*:294:294:Audio and MediaExperience
Daemon:/var/db/audiomxd:/usr/bin/false
_terminusd*:295:295:Terminus:/var/empty:/usr/bin/false
_neuralengine*:296:296:AppleNeuralEngine:/var/db/neuralengine:/usr/bin/false
_oahd*:441:441:OAH Daemon:/var/empty:/usr/bin/false
```

4 Generator comprehensions

```
[36]: # list comprehension
```

```
[x*x
for x in range(-10, 10)]
```

```
[36]: [100, 81, 64, 49, 36, 25, 16, 9, 4, 1, 0, 1, 4, 9, 16, 25, 36, 49, 64, 81]
```

```
[37]: # set comprehension
```

```
{x*x
for x in range(-10, 10)}
```

```
[37]: {0, 1, 4, 9, 16, 25, 36, 49, 64, 81, 100}
```

```
[38]: # dict comprehension
```

```
{x : x*x
for x in range(-10, 10)}
```

```
[38]: {-10: 100,
      -9: 81,
      -8: 64,
      -7: 49,
      -6: 36,
      -5: 25,
      -4: 16,
      -3: 9,
      -2: 4,
      -1: 1,
      0: 0,
      1: 1,
      2: 4,
      3: 9,
```

```
4: 16,  
5: 25,  
6: 36,  
7: 49,  
8: 64,  
9: 81}
```

```
[41]: # generator expression / generator comprehension
```

```
g = (x*x  
     for x in range(-10, 10))  
g
```

```
[41]: <generator object <genexpr> at 0x10cd871d0>
```

```
[42]: for one_item in g:  
      print(one_item)
```

```
100  
81  
64  
49  
36  
25  
16  
9  
4  
1  
0  
1  
4  
9  
16  
25  
36  
49  
64  
81
```

```
[43]: mylist = [10, 20, 30]
```

```
'*'.join(mylist)    # this won't work -- only can pass a list of strings
```

```
-----  
TypeError                                Traceback (most recent call last)  
Cell In[43], line 3  
      1 mylist = [10, 20, 30]  
----> 3 '*' .join(mylist)    # this won't work -- only can pass a list of strings
```

TypeError: sequence item 0: expected str instance, int found

```
[44]: # we can use a list comprehension here
```

```
'*'.join([str(one_item)
          for one_item in mylist])
```

```
[44]: '10*20*30'
```

```
[45]: # we can also use a generator comprehension
```

```
'*'.join(    (str(one_item)
              for one_item in mylist)    )
```

```
[45]: '10*20*30'
```

```
[46]: # what about this:
```

```
# we can remove the inner parentheses and it works fine!
```

```
'*'.join(    str(one_item)
            for one_item in mylist    )
```

```
[46]: '10*20*30'
```

```
[52]: g = (    print(one_item)
            for one_item in mylist    )
```

```
[51]: print(next(g))
```

```
20
None
```

```
[53]: list(g)
```

```
10
20
30
```

```
[53]: [None, None, None]
```

```
[54]: numbers = {x*x
                for x in range(-10, 10)}
```

```
[55]: print(numbers)    # __repr__
```

```
{64, 1, 0, 100, 36, 4, 9, 16, 81, 49, 25}
```

```
[56]: numbers    # __str__
```

```
[56]: {0, 1, 4, 9, 16, 25, 36, 49, 64, 81, 100}
```

```
[57]: d = {}  
      d['a'] = 100
```

```
[59]: hash('a') % 8
```

```
[59]: 4
```

5 Dict talk by Raymond Hettinger

<https://www.youtube.com/watch?v=p33CVV29OG8>

6 Exercise: Only vowels

Write a generator expression that returns the vowels (a, e, i, o, and u) from a file

Example:

```
for one_item in g:  
    print(one_item)
```

or

```
list(g)
```

```
[65]: filename = '/etc/passwd'  
  
g = ( one_character  
      for one_line in open(filename)  
      if not one_line.startswith('#')  
      for one_character in one_line  
      if one_character.lower() in 'aeiou')  
  
for one_item in g:  
    print(one_item, end=' ')
```

```
U e a a a e o e a i i e i o u e i e o e e e i u i i i e u e o e A o e i e i i o  
a i o i o i e O e i e o e e e o e i e o a a e o a i i o a i o a i o a o u O e i  
e o o o U i i e e U e a e u i a e o o o e A i i a o a o o i a e o e e i e a o o u  
i a e u u U i o U i o o o o a o o u u u i u u i o a a e a a e a e o a e u i a e  
e o e o e i e a e o u i a e i a a i a I a A i a a e u i a e i i e i e a o o u u  
i a e o i o i a i e e a o o o i u i a e e i e o i u a i o e i e a e u i a e e e  
i i a e E o e e i e a e u i a e a o e a A o e e i e a a o e u i a e a A a u a e  
u i a e a e e e A e E e a e o a e u i a e e o e o e i e a e o a e o u i a e e o  
e e o e o u e a i o a e u i a e a o e a e a e u i a e e o e e o e a e u i a e a  
A e e o e e o a e u i a e o i e e e e i a e e e u i a e e A e E e U e a e u i a  
e e e a e u i a e e e a e u i a e e e a e u i a e i i e e e a a i o a e u i a e  
u i i e e a i e e a e u i a e u u A i i a o a i a u i a e a i a a i a i e e a e
```

u i a e a e e A i a i o e e a e u i a e a a a A a e o a i u a i u i a e a a i A
a i a e o a i u a i u i a e a e a e e e a e u i a e a o e A i a i o O e a e u i
a e i o e e i o e e a e u i a e o i o i a e u i a e o e o e a e o a e u i a e e
u i a e e u i A e a e u i a e u i a e a e a a e a a e u i a e e a e e e a e e a
e a e e u i a e u a e a i U a e a i a e u i a e i a e I a e a e u i a e a e e A
e e a e u i a e a e o a e u i a e u o U o U e a e u i a e o a e u a e o a e U a
e e i e a o a e u a e u i a e o e a u i o o e A u i o a e o a e u i a e e e a e
e e a e a e u i a e o a i o o a i o a e o a o a i o u i a e u e a u a i o a e u
E a u a i o A e a e u i a e i e o e A u o i e o e a e o a e u i a e a o a e i e
A e a e u i a e o o o o a e u i a e u u i o e O e i e e e a o o u i a e o e o o
e o A i i a o a e u i a e a u i o A u i o a e u i a e o e o e e e a e u i a e e
e o i e a i i e a e u i a e a i a i e e o A i e i e a e u i a e a i a e e e o a
e a o e i e a e u i a e e i e e i e a a e e e e a e u i a e e a u e e e A u e e
a e u i a e e i o e I O a e u i a e a a a e o a e u i a e o e u o e o A u e i a
i o a e u i a e e a i i e o a i i a e o a e u i a e a e i e E e e A e i e a e o
a e u i a e O e i e o e e o i e a i i e a e u i a e a i O e i e o e e o A i e i
e a e u i a e a e O e i e o e e o a e a o e i e a e u i a e e e o O e i e o e e
o a e u i a e a o o u O e i e o e e o A o o u a e u i a e a e a e A e a e e i e
a e u i a e o e e i a i o o e e i a I O a e o a e u i a e a u e i e a u e i e a
e u i a e i o e i e I o e i e a e u i a e i o e i o e a e u i a e u e i o U e i
o a e o a u e i o u i a e i a o i i a o i a e o a e u i a e a i A i e i e a a i
u i a e a e e o A A o u a e u i a e a e o o e a e o o e a e o a e u i a e e u u
e e u U e a e u i a o e a O e a e o u e a e o a o e a u i a e e e o a O e e o u
e e i e a e u i a e o o a e u i a e o i e a e o i e A e U e a a u i a e i e i e
i e i e a e o a i e i e u i a e a a e e o a a e e o a a e e o u i a e a i e a
e a i e a e a e u i a e A o u a e u i a e a e a a e a A o u a a e a u i a e i I
e i e U e a i u i a e i o a a i a o e e i a I O A i a U e a i o a a i a u i a e
a a i A a i a e o a a a i u i a e a e o a u i a e i e i e a e o a i e u i a e e
a o i i a a i a e o a e a u i a e e o e o e e i o e o e o E e i o a e o e o e e
i o u i a e i e i e i e i a e u i a e i i a e i o i I a e I O a e o a i i a e i o
u i a e o o a e o a i a o i u i a e a i a A I a a e o a a i a u i a e i a o o i
a i o I a o o i a i o a e o a i a o o i a i o u i a e e o e o a e o a e u i a e
e o e a a e e a e o a u i a e a e o u a e A e o U a e a e o a a e o u a e u i a
e o e e a o e e a a e o a o e e a u i a e o e o e e i e a o e u i a e e e a e o
a e u i a e u u a e u i a e a i e a e a i e a e a a i e a e u i a e a i a e o a
i a e o a a i a e o u i a e o i i a i o o o i i a i o o a e u i a e a i i e A e
i u a a o I i e a e u i a e i o e i o e a i o e u i a e a o u a e a o u A e e i
e a e u i a e o i e e a e e o i e e a e e a e u i a e a u i o A u i o a e i a E
e i e e a e o a a u i o u i a e e i u e i u a e u i a e e u a e i e A e e u a E
i e a e u a e i e u i a e o a O A a e o a e u i a e

7 Next up

1. Threads
2. Multiprocessing

Resume at :25

GIL – global interpreter lock

only one thread executes at a time

8 Exercise: File vowels

1. Define a function, `count_vowels`, that takes a filename as an input. It uses `q.put` to return a tuple with two elements:
 - the filename
 - a dictionary with keys a, e, i, o, and u as an output. The values will be integers, the number of times each vowel appears in a file.
2. Use threads to start this function once per file in a directory (or a list of files that you provide). You can use `os.listdir` or `glob.glob`.
3. When all of the threads are done, go through the queue and print all of the filenames and the reports they've made.
4. If a file doesn't work (binary, no permission, etc.), then just ignore it.

[]: