第十章 Python标准库

Python自身提供了比较丰富的生态，拿来即用，可极大的提高开发效率

10.1 time库

Python处理时间的标准库

1、获取现在时间

（1）time.localtime() 本地时间

（2）time.gmtime() UTC世界统一时间

北京时间比时间统一时间UTC早8个小时

In [4]:

```
import time

t_local = time.localtime()
t_UTC = time.gmtime()
print("t_local", t_local)           # 本地时间
print("t_UTC", t_UTC)               # UTC统一时间
```

```
t_local time.struct_time(tm_year=2019, tm_mon=8, tm_mday=29, tm_hour=16, tm_min=43,
tm_sec=37, tm_wday=3, tm_yday=241, tm_isdst=0)
t_UTC time.struct_time(tm_year=2019, tm_mon=8, tm_mday=29, tm_hour=8, tm_min=43, tm_
sec=37, tm_wday=3, tm_yday=241, tm_isdst=0)
```

In [5]:

```
time.ctime()                    # 返回本地时间的字符串
```

Out[5]:

```
'Thu Aug 29 16:44:52 2019'
```

2、时间戳与计时器

（1）time.time()　返回自纪元以来的秒数，记录sleep

（2）time.perf_counter()　随意选取一个时间点，记录现在时间到该时间点的间隔秒数，记录sleep

（3）time.process_time()　随意选取一个时间点，记录现在时间到该时间点的间隔秒数，不记录sleep

perf_counter()精度较time()更高一些

In [6]:

```
t_1_start = time.time()
t_2_start = time.perf_counter()
t_3_start = time.process_time()
print(t_1_start)
print(t_2_start)
print(t_3_start)

res = 0
for i in range(1000000):
    res += i

time.sleep(5)
t_1_end = time.time()
t_2_end = time.perf_counter()
t_3_end = time.process_time()

print("time方法：{:.3f}秒".format(t_1_end-t_1_start))
print("perf_counter方法：{:.3f}秒".format(t_2_end-t_2_start))
print("process_time方法：{:.3f}秒".format(t_3_end-t_3_start))
```

```
1567068710.7269545
6009.0814064
2.25
time方法：5.128秒
perf_counter方法：5.128秒
process_time方法：0.125秒
```

3、格式化

（1）time.strftime 自定义格式化输出

In [7]:

```
lctime = time.localtime()
time.strftime("%Y-%m-%d %A %H:%M:%S", lctime)
```

Out[7]:

```
'2019-08-29 Thursday 16:54:35'
```

4、睡觉觉

（1）time.sleep()

10.2 random库

随机数在计算机应用中十分常见

Python通过random库提供各种伪随机数

基本可以用于除加密解密算法外的大多数工程应用

1、随机种子——seed(a=None)

（1）相同种子会产生相同的随机数

（2）如果不设置随机种子，以系统当前时间为默认值

In [8]:

```
from random import *

seed(10)
print(random())
seed(10)
print(random())
```

```
0.5714025946899135
0.5714025946899135
```

In [11]:

```
print(random())
```

```
0.20609823213950174
```

2、产生随机整数

（1）randint(a, b)——产生[a, b]之间的随机整数

In [14]:

```
numbers = [randint(1,10) for i in range(10)]
numbers
```

Out[14]:

```
[3, 5, 6, 3, 8, 4, 8, 10, 7, 1]
```

（2）randrange(a)——产生[0, a)之间的随机整数

In [17]:

```
numbers = [randrange(10) for i in range(10)]
numbers
```

Out[17]:

```
[6, 3, 0, 0, 7, 4, 9, 1, 8, 1]
```

（3）randrange(a, b, step)——产生[a, b)之间以setp为步长的随机整数

In [18]:

```
numbers = [randrange(0, 10, 2) for i in range(10)]
numbers
```

Out[18]:

[2, 6, 8, 4, 8, 2, 0, 0, 6, 2]

3、产生随机浮点数

（1）random()——产生[0.0, 1.0)之间的随机浮点数

In [19]:

```
numbers = [random() for i in range(10)]
numbers
```

Out[19]:

[0.9819392547566425,
 0.19092611184488173,
 0.3486810954900942,
 0.9704866291141572,
 0.4456072691491385,
 0.6807895695768549,
 0.14351321471670841,
 0.5218569500629634,
 0.8648825892767497,
 0.26702706855337954]

（2）uniform(a, b)——产生[a, b]之间的随机浮点数

In [20]:

```
numbers = [uniform(2.1, 3.5) for i in range(10)]
numbers
```

Out[20]:

[2.523598043850906,
 3.0245903649048116,
 3.4202356766870463,
 2.344031169179946,
 2.3465252151503173,
 3.181989084829388,
 2.5592895031615703,
 2.413131937436849,
 2.8627907782614415,
 2.16114212173462]

4、序列用函数

（1）choice(seq)——从序列类型中随机返回一个元素

In [27]:

```
choice(['win', 'lose', 'draw'])
```

Out[27]:

'draw'

In [29]:

```
choice("python")
```

Out[29]:

'h'

(2) choices(seq,weights=None, k)——对序列类型进行k次重复采样，可设置权重

In [30]:

```
choices(['win', 'lose', 'draw'], k=5)
```

Out[30]:

['draw', 'lose', 'draw', 'draw', 'draw']

In [33]:

```
choices(['win', 'lose', 'draw'], [4,4,2], k=10)
```

Out[33]:

['lose', 'draw', 'lose', 'win', 'draw', 'lose', 'draw', 'win', 'win', 'lose']

(3) shuffle(seq)——将序列类型中元素随机排列，返回打乱后的序列

In [35]:

```
numbers = ["one", "two", "three", "four"]
shuffle(numbers)
numbers
```

Out[35]:

['four', 'one', 'three', 'two']

(4) sample(pop, k)——从pop类型中随机选取k个元素，以列表类型返回

In [40]:

```
sample([10, 20, 30, 40, 50], k=3)
```

Out[40]:

[20, 30, 10]

5、概率分布——以高斯分布为例

gauss(mean, std)——生产一个符合高斯分布的随机数

In [42]:

```
number = gauss(0, 1)
number
```

Out[42]:

0.6331522345532208

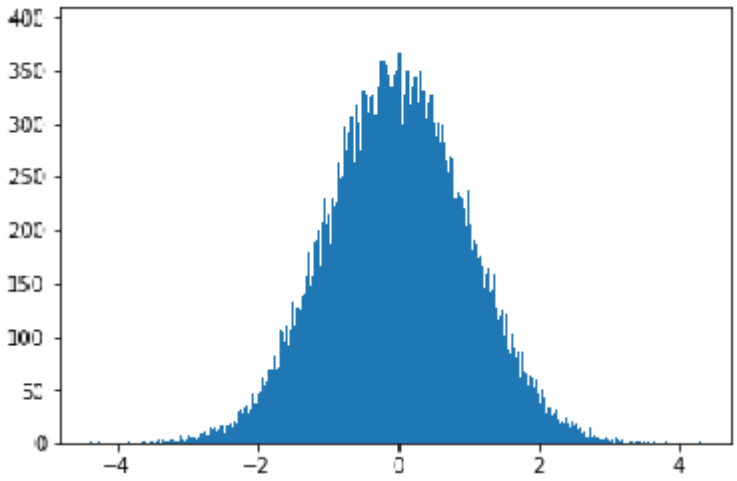
多生成几个

In [44]:

```
import matplotlib.pyplot as plt

res = [gauss(0, 1) for i in range(100000)]

plt.hist(res, bins=1000)
plt.show()
```



【例1】用random库实现简单的微信红包分配

In [47]:

```python
import random


def red_packet(total, num):
    for i in range(1, num):
        per = random.uniform(0.01, total/(num-i+1)*2)           # 保证每个人获得红包的期望是tota
        total = total - per
        print("第{}位红包金额：  {:.2f}元".format(i, per))
    else:
        print("第{}位红包金额：  {:.2f}元".format(num, total))


red_packet(10, 5)
```

```
第1位红包金额：  1.85元
第2位红包金额：  3.90元
第3位红包金额：  0.41元
第4位红包金额：  3.30元
第5位红包金额：  0.54元
```

In [50]:

```
import random
import numpy as np


def red_packet(total, num):
    ls = []
    for i in range(1, num):
        per = round(random.uniform(0.01, total/(num-i+1)*2), 2)      # 保证每个人获得红包的期望
        ls.append(per)
        total = total - per
    else:
        ls.append(total)

    return ls


# 重复发十万次红包，统计每个位置的平均值（约等于期望）
res = []
for i in range(100000):
    ls = red_packet(10,5)
    res.append(ls)

res = np.array(res)
print(res[:10])
np.mean(res, axis=0)
```

```
[[1.71 1.57 0.36 1.25 5.11]
 [1.96 0.85 1.46 3.29 2.44]
 [3.34 0.27 1.9  0.64 3.85]
 [1.99 1.08 3.86 1.69 1.38]
 [1.56 1.47 0.66 4.09 2.22]
 [0.57 0.44 1.87 5.81 1.31]
 [0.47 1.41 3.97 1.28 2.87]
 [2.65 1.82 1.22 2.02 2.29]
 [3.16 1.2  0.3  3.66 1.68]
 [2.43 0.16 0.11 0.79 6.51]]
```

Out[50]:

```
array([1.9991849, 2.0055725, 2.0018144, 2.0022472, 1.991181 ])
```

【例2】生产4位由数字和英文字母构成的验证码

In [65]:

```
import random
import string

print(string.digits)
print(string.ascii_letters)

s=string.digits + string.ascii_letters
v=random.sample(s,4)
print(v)
print(''.join(v))
```

```
0123456789
abcdefghijklmnopqrstuvwxyzABCDEFGHIJKLMNOPQRSTUVWXYZ
['n', 'Q', '4', '7']
nQ47
```

10.3 collections库——容器数据类型

In [67]:

```
import collections
```

1、namedtuple——具名元组

- 点的坐标，仅看数据，很难知道表达的是一个点的坐标

In [ ]:

```
p = (1, 2)
```

- 构建一个新的元组子类

  定义方法如下：typename 是元组名字，field_names 是域名

In [ ]:

```
collections.namedtuple(typename, field_names, *, rename=False, defaults=None, module=None)
```

In [74]:

```
Point = collections.namedtuple("Point", ["x", "y"])
p = Point(1, y=2)
p
```

Out[74]:

```
Point(x=1, y=2)
```

- 可以调用属性

In [70]:

```
print(p.x)
print(p.y)
```

```
1
2
```

- 有元组的性质

In [71]:

```
print(p[0])
print(p[1])
x, y = p
print(x)
print(y)
```

```
1
2
1
2
```

- 确实是元组的子类

In [76]:

```
print(isinstance(p, tuple))
```

```
True
```

【例】模拟扑克牌

In [77]:

```
Card = collections.namedtuple("Card", ["rank", "suit"])
ranks = [str(n) for n in range(2, 11)] + list("JQKA")
suits = "spades diamonds clubs hearts".split()
print("ranks", ranks)
print("suits", suits)
cards = [Card(rank, suit) for rank in ranks
                          for suit in suits]
cards
```

```
ranks ['2', '3', '4', '5', '6', '7', '8', '9', '10', 'J', 'Q', 'K', 'A']
suits ['spades', 'diamonds', 'clubs', 'hearts']
```

Out[77]:

```
[Card(rank='2', suit='spades'),
 Card(rank='2', suit='diamonds'),
 Card(rank='2', suit='clubs'),
 Card(rank='2', suit='hearts'),
 Card(rank='3', suit='spades'),
 Card(rank='3', suit='diamonds'),
 Card(rank='3', suit='clubs'),
 Card(rank='3', suit='hearts'),
 Card(rank='4', suit='spades'),
 Card(rank='4', suit='diamonds'),
 Card(rank='4', suit='clubs'),
 Card(rank='4', suit='hearts'),
 Card(rank='5', suit='spades'),
 Card(rank='5', suit='diamonds'),
 Card(rank='5', suit='clubs'),
 Card(rank='5', suit='hearts'),
 Card(rank='6', suit='spades'),
 Card(rank='6', suit='diamonds'),
 Card(rank='6', suit='clubs'),
 Card(rank='6', suit='hearts'),
 Card(rank='7', suit='spades'),
 Card(rank='7', suit='diamonds'),
 Card(rank='7', suit='clubs'),
 Card(rank='7', suit='hearts'),
 Card(rank='8', suit='spades'),
 Card(rank='8', suit='diamonds'),
 Card(rank='8', suit='clubs'),
 Card(rank='8', suit='hearts'),
 Card(rank='9', suit='spades'),
 Card(rank='9', suit='diamonds'),
 Card(rank='9', suit='clubs'),
 Card(rank='9', suit='hearts'),
 Card(rank='10', suit='spades'),
 Card(rank='10', suit='diamonds'),
 Card(rank='10', suit='clubs'),
 Card(rank='10', suit='hearts'),
 Card(rank='J', suit='spades'),
 Card(rank='J', suit='diamonds'),
 Card(rank='J', suit='clubs'),
 Card(rank='J', suit='hearts'),
 Card(rank='Q', suit='spades'),
 Card(rank='Q', suit='diamonds'),
 Card(rank='Q', suit='clubs'),
 Card(rank='Q', suit='hearts'),
 Card(rank='K', suit='spades'),
```

```
 Card(rank='K', suit='diamonds'),
 Card(rank='K', suit='clubs'),
 Card(rank='K', suit='hearts'),
 Card(rank='A', suit='spades'),
 Card(rank='A', suit='diamonds'),
 Card(rank='A', suit='clubs'),
 Card(rank='A', suit='hearts')]
```

In [28]:

```
from random import *
```

In [78]:

```
# 洗牌
shuffle(cards)
cards
```

```
 Card(rank='J', suit='diamonds'),
 Card(rank='K', suit='clubs'),
 Card(rank='4', suit='spades'),
 Card(rank='2', suit='diamonds'),
 Card(rank='Q', suit='spades'),
 Card(rank='A', suit='clubs'),
 Card(rank='A', suit='diamonds'),
 Card(rank='6', suit='hearts'),
 Card(rank='7', suit='diamonds'),
 Card(rank='5', suit='diamonds'),
 Card(rank='10', suit='clubs'),
 Card(rank='8', suit='clubs'),
 Card(rank='9', suit='clubs'),
 Card(rank='6', suit='clubs'),
 Card(rank='6', suit='diamonds'),
 Card(rank='5', suit='clubs'),
 Card(rank='3', suit='diamonds'),
 Card(rank='4', suit='hearts'),
 Card(rank='3', suit='clubs'),
```

In [80]:

```
# 随机抽一张牌
choice(cards)
```

Out[80]:

```
Card(rank='4', suit='hearts')
```

In [82]:

```
# 随机抽多张牌
sample(cards, k=5)
```

Out[82]:

```
[Card(rank='4', suit='hearts'),
 Card(rank='2', suit='clubs'),
 Card(rank='Q', suit='diamonds'),
 Card(rank='9', suit='spades'),
 Card(rank='10', suit='hearts')]
```

2、Counter——计数器工具

In [84]:

```
from collections import Counter
```

In [85]:

```
s = "牛奶奶找刘奶奶买牛奶"
colors = ['red', 'blue', 'red', 'green', 'blue', 'blue']
cnt_str = Counter(s)
cnt_color = Counter(colors)
print(cnt_str)
print(cnt_color)
```

```
Counter({'奶': 5, '牛': 2, '找': 1, '刘': 1, '买': 1})
Counter({'blue': 3, 'red': 2, 'green': 1})
```

- 是字典的一个子类

In [86]:

```
print(isinstance(Counter(), dict))
```

```
True
```

- 最常见的统计——most_commom(n)
  提供 n 个频率最高的元素和计数

In [87]:

```
cnt_color.most_common(2)
```

Out[87]:

```
[('blue', 3), ('red', 2)]
```

- 元素展开——elements()

In [88]:

```
list(cnt_str.elements())
```

Out[88]:

```
['牛', '牛', '奶', '奶', '奶', '奶', '奶', '找', '刘', '买']
```

- 其他一些加减操作

In [89]:

```
c = Counter(a=3, b=1)
d = Counter(a=1, b=2)
c+d
```

Out[89]:

```
Counter({'a': 4, 'b': 3})
```

【例】从一副牌中抽取10张，大于10的比例有多少

In [92]:

```
cards = collections.Counter(tens=16, low_cards=36)
seen = sample(list(cards.elements()), k=10)
print(seen)
```

```
['tens', 'low_cards', 'low_cards', 'low_cards', 'tens', 'tens', 'low_cards', 'low_ca
rds', 'low_cards', 'low_cards']
```

In [93]:

```
seen.count('tens') / 10
```

Out[93]:

```
0.3
```

3、deque——双向队列

列表访问数据非常快速

插入和删除操作非常慢——通过移动元素位置来实现

特别是 insert(0, v) 和 pop(0)，在列表开始进行的插入和删除操作

双向队列可以方便的在队列两边高效、快速的增加和删除元素

In [94]:

```
from collections import deque

d = deque('cde')
d
```

Out[94]:

```
deque(['c', 'd', 'e'])
```

In [95]:

```
d.append("f")              # 右端增加
d.append("g")
d.appendleft("b")          # 左端增加
d.appendleft("a")
d
```

Out[95]:

```
deque(['a', 'b', 'c', 'd', 'e', 'f', 'g'])
```

In [96]:

```
d.pop()             # 右端删除
d.popleft()         # 左端删除
d
```

Out[96]:

```
deque(['b', 'c', 'd', 'e', 'f'])
```

deque 其他用法可参考官方文档

10.4 itertools库——迭代器

1、排列组合迭代器

（1）product——笛卡尔积

In [97]:

```
import itertools

for i in itertools.product('ABC', '01'):
    print(i)
```

```
('A', '0')
('A', '1')
('B', '0')
('B', '1')
('C', '0')
('C', '1')
```

In [98]:

```
for i in itertools.product('ABC', repeat=3):
    print(i)
```

```
('A', 'A', 'A')
('A', 'A', 'B')
('A', 'A', 'C')
('A', 'B', 'A')
('A', 'B', 'B')
('A', 'B', 'C')
('A', 'C', 'A')
('A', 'C', 'B')
('A', 'C', 'C')
('B', 'A', 'A')
('B', 'A', 'B')
('B', 'A', 'C')
('B', 'B', 'A')
('B', 'B', 'B')
('B', 'B', 'C')
('B', 'C', 'A')
('B', 'C', 'B')
('B', 'C', 'C')
('C', 'A', 'A')
```

(2) permutations——排列

In [99]:

```
for i in itertools.permutations('ABCD', 3):   # 3 是排列的长度
    print(i)
```

```
('A', 'B', 'C')
('A', 'B', 'D')
('A', 'C', 'B')
('A', 'C', 'D')
('A', 'D', 'B')
('A', 'D', 'C')
('B', 'A', 'C')
('B', 'A', 'D')
('B', 'C', 'A')
('B', 'C', 'D')
('B', 'D', 'A')
('B', 'D', 'C')
('C', 'A', 'B')
('C', 'A', 'D')
('C', 'B', 'A')
('C', 'B', 'D')
('C', 'D', 'A')
('C', 'D', 'B')
('D', 'A', 'B')
('D', 'A', 'C')
('D', 'B', 'A')
('D', 'B', 'C')
('D', 'C', 'A')
('D', 'C', 'B')
```

In [100]:

```
for i in itertools.permutations(range(3)):
    print(i)
```

```
(0, 1, 2)
(0, 2, 1)
(1, 0, 2)
(1, 2, 0)
(2, 0, 1)
(2, 1, 0)
```

(3) combinations——组合

In [101]:

```
for i in itertools.combinations('ABCD', 2):  # 2是组合的长度
    print(i)
```

```
('A', 'B')
('A', 'C')
('A', 'D')
('B', 'C')
('B', 'D')
('C', 'D')
```

In [102]:

```
for i in itertools.combinations(range(4), 3):
    print(i)
```

```
(0, 1, 2)
(0, 1, 3)
(0, 2, 3)
(1, 2, 3)
```

(4) combinations_with_replacement——元素可重复组合

In [103]:

```
for i in itertools.combinations_with_replacement('ABC', 2):  # 2是组合的长度
    print(i)
```

```
('A', 'A')
('A', 'B')
('A', 'C')
('B', 'B')
('B', 'C')
('C', 'C')
```

In [104]:

```
for i in itertools.product('ABC',repeat=2):
    print(i)
```

```
('A', 'A')
('A', 'B')
('A', 'C')
('B', 'A')
('B', 'B')
('B', 'C')
('C', 'A')
('C', 'B')
('C', 'C')
```

2、拉链

（1）zip——短拉链

In [105]:

```
for i in zip("ABC", "012", "xyz"):
    print(i)
```

```
('A', '0', 'x')
('B', '1', 'y')
('C', '2', 'z')
```

长度不一时，执行到最短的对象处，就停止

In [107]:

```
for i in zip("ABC", [0, 1, 2, 3, 4, 5]):          # 注意zip是内置的，不需要加itertools
    print(i)
```

```
('A', 0)
('B', 1)
('C', 2)
```

（2）zip_longest——长拉链

长度不一时，执行到最长的对象处，就停止，缺省元素用None或指定字符替代

In [108]:

```
for i in itertools.zip_longest("ABC", "012345"):
    print(i)
```

```
('A', '0')
('B', '1')
('C', '2')
(None, '3')
(None, '4')
(None, '5')
```

In [109]:

```
for i in itertools.zip_longest("ABC", "012345", fillvalue = "?"):
    print(i)
```

```
('A', '0')
('B', '1')
('C', '2')
('?', '3')
('?', '4')
('?', '5')
```

3、无穷迭代器

(1) count(start=0, step=1)——计数

创建一个迭代器，它从 start 值开始，返回均匀间隔的值

In [ ]:

```
itertools.count(10)
10
11
12
.
.
.
```

(2) cycle(iterable)——循环

创建一个迭代器，返回 iterable 中所有元素，无限重复

In [ ]:

```
itertools.cycle("ABC")
A
B
C
A
B
C
.
.
.
```

(3) repeat(object [, times])——重复

创建一个迭代器，不断重复 object 。除非设定参数 times ，否则将无限重复

In [110]:

```
for i in itertools.repeat(10, 3):
    print(i)
```

```
10
10
10
```

4、其他

（1）chain(iterables)——锁链

把一组迭代对象串联起来，形成一个更大的迭代器

In [111]:

```
for i in itertools.chain('ABC', [1, 2, 3]):
    print(i)
```

```
A
B
C
1
2
3
```

（2）enumerate(iterable, start=0)——枚举（Python内置）

产出由两个元素组成的元组，结构是（index, item）,其中index 从start开始，item从iterable中取

In [112]:

```
for i in enumerate("Python", start=1):
    print(i)
```

```
(1, 'P')
(2, 'y')
(3, 't')
(4, 'h')
(5, 'o')
(6, 'n')
```

（3）groupby(iterable, key=None)——分组

创建一个迭代器，按照key指定的方式，返回 iterable 中连续的键和组
一般来说，要预先对数据进行排序
key为None默认把连续重复元素分组

In [113]:

```
for key, group in itertools.groupby('AAAABBBCCDAABBB'):
    print(key, list(group))
```

```
A ['A', 'A', 'A', 'A']
B ['B', 'B', 'B']
C ['C', 'C']
D ['D']
A ['A', 'A']
B ['B', 'B', 'B']
```

In [114]:

```
animals = ["duck", "eagle", "rat", "giraffe", "bear", "bat", "dolphin", "shark", "lion"]
animals.sort(key=len)
print(animals)
```

```
['rat', 'bat', 'duck', 'bear', 'lion', 'eagle', 'shark', 'giraffe', 'dolphin']
```

In [115]:

```
for key, group in itertools.groupby(animals, key=len):
    print(key, list(group))
```

```
3 ['rat', 'bat']
4 ['duck', 'bear', 'lion']
5 ['eagle', 'shark']
7 ['giraffe', 'dolphin']
```

In [116]:

```
animals = ["duck", "eagle", "rat", "giraffe", "bear", "bat", "dolphin", "shark", "lion"]
animals.sort(key=lambda x: x[0])
print(animals)
for key, group in itertools.groupby(animals, key=lambda x: x[0]):
    print(key, list(group))
```

```
['bear', 'bat', 'duck', 'dolphin', 'eagle', 'giraffe', 'lion', 'rat', 'shark']
b ['bear', 'bat']
d ['duck', 'dolphin']
e ['eagle']
g ['giraffe']
l ['lion']
r ['rat']
s ['shark']
```

itertools 其他函数可参考官方文档