

# Python

2018年10月21日 星期日 16:20

- ★ 中文解决方法为只要在文件开头加入 `# -*- coding: UTF-8 -*-` 或者 `#coding=utf-8` 就行了

## ★ 基本输入输出

```
x = float(input("Enter the value of x: "))
Python3 中没有raw_input(), 只有input()
```

Print 输出方式:

EG:

- `print ([[a,b,c] for a in range(x+1) for b in range(y+1) for c in range(z+1) if a+b+c != n])`
- `second_highest = sorted(list(set([marks for name, marks in marksheets])))[1]`
- `print('\n'.join([a for a,b in sorted(marksheets) if b == second_highest]))`

---

## ★ enumerate() 和 zip() 函数:

`enumerate()` returns a tuple containing a count (from `start` which defaults to 0)

```
>>> seasons = ['Spring', 'Summer', 'Fall', 'Winter']
>>> list(enumerate(seasons))
[(0, 'Spring'), (1, 'Summer'), (2, 'Fall'), (3, 'Winter')]
>>> list(enumerate(seasons, start=1))
[(1, 'Spring'), (2, 'Summer'), (3, 'Fall'), (4, 'Winter')]
animals = ['cat', 'dog', 'monkey']
for idx, animal in enumerate(animals):
    print("#%d: %s" % (idx + 1, animal))
# Prints "#1: cat", "#2: dog", "#3: monkey", each on its own line
```

- ★ `print("my name is %s. I am %d years old" % ('Shixiaolou', 4))`

## ★ Xrange and range difference :

Python3 里面直接用 `range` 就好

`range` creates a list, so if you do `range(1, 10000000)` it creates a list in memory with 9999999 elements.

`xrange` is a sequence object that evaluates lazily.

This is true, but in Python 3, `.range()` will be implemented by the Python 2 `.xrange()`. If you need to actually generate the list, you will need to do:  
`list(range(1,100))`

---

## ★ Map() 函数会根据提供的函数对指定的序列做映射

```
>>> def square(x) : # 计算平方数
...     return x ** 2 ...
>>> map(square, [1,2,3,4,5]) # 计算列表各个元素的平方
[1, 4, 9, 16, 25]
>>> map(lambda x: x ** 2, [1, 2, 3, 4, 5]) # 使用 lambda 匿名函数
[1, 4, 9, 16, 25]
# 提供了两个列表, 对相同位置的列表数据进行相加
>>> map(lambda x, y: x + y, [1, 3, 5, 7, 9], [2, 4, 6, 8, 10])
[3, 7, 11, 15, 19]
```

- 
- ★ Python 有 5 个标准数据类型: `numbers`(数字), `string`(字符串), `list`(列表), `tuple`(元组), `dictionary()`

总结: 花括号是字典, 中括号是列表, 小括号是元组

Python 支持四种不同的数字类型：

- int (有符号整型)
- long (长整型[也可以代表八进制和十六进制])
- float (浮点型)
- complex (复数)

```
=====
=====
```

## ★ Python 列表 list

列表可以完成大多数集合类的数据结构实现。它支持字符、数字、字符串甚至可以包含列表（即嵌套）。

列表用 [ ] 标识，是 python 最通用的复合数据类型。可以用 append() 来添加列表项

列表中值的切割也可以用到变量 [头下标:尾下标]，就可以截取相应的列表，从左到右索引默认 0 开始，从右到左索引默认 -1 开始，下标可以为空表示取到头或尾。

加号 + 是列表连接运算符，星号 \* 是重复操作。

```
list = [ 'runoob', 786 , 2.23, 'john', 70.2 ]
tinylist = [123, 'john']
print list # 输出完整列表
print list[0] # 输出列表的第一个元素
print list[1:3] # 输出第二个至第三个元素
```

plus, list() 函数正常是把元组转换成列表

```
Eg.: aTuple = (123, 'xyz', 'zara', 'abc');
aList = list(aTuple)
print "列表元素 : ", aList
```

```
=====
=====
```

## set:

Plus, set() 函数穿件一个无序不重复元素集，可进行关系测试，删除重复数据，还可以计算交集、差集、并集等。

EG.

```
class set([iterable])
参数说明: iterable -- 可迭代对象对象;
>>>x = set('runoob')
>>> y = set('google')
>>> x, y (set(['b', 'r', 'u', 'o', 'n']), set(['e', 'o', 'g',
'�'])) # 重复的被删除
>>> x & y # 交集 set(['o'])
>>> x | y # 并集 set(['b', 'e', 'g', '�', 'o', 'n', 'r', 'u'])
>>> x - y # 差集 set(['r', 'b', 'u', 'n'])

print(len(set([input() for x in range(int(input()))])))
```

set 更多对 list 类型进行操作：

```
k,arr = int(input()),list(map(int, input().split()))
myset = set(arr)
```

```
=====
=====
```

## ★ Python 元组

元组用 () 标识。内部元素用逗号隔开。但是元组不能二次赋值，相当于只读列表。

```
tuple = ( 'runoob', 786 , 2.23, 'john', 70.2 )
print tuple[0] # 输出元组的第一个元素
print tuple[1:3] # 输出第二个至第三个的元素
```

- Cmp(tuple1,tuple2)
- Len(tuple)
- Max(tuple)
- Min(tuple)
- Tuple(seq) 将列表转换为元组

```
=====
=====
```

## ★ Python 字典

字典(dictionary)是除列表以外python之中最灵活的内置数据结构类型。列表是有序的对象集合，字典是无序的对象集合。

两者之间的区别在于：字典当中的元素是通过键来存取的，而不是通过偏移存取。

字典用"{}"标识。字典由索引(key)和它对应的值value组成。

```
dict = {}
dict['one'] = "This is one"
dict[2] = "This is two"
tinydict = {'name': 'john', 'code':6734, 'dept': 'sales'}
print dict['one'] # 输出键为'one' 的值
print dict[2] # 输出键为 2 的值
```

## ★ Str(x) 将对象x转换为字符串； eval(str) 用来计算在字符串汇总的有效Python表达式，并返回一个对象

## ★ Lambda 表达式：匿名函数

### ★ Sorted()函数

**sort 与 sorted 区别：**

sort 是应用在 list 上的方法，sorted 可以对所有可迭代的对象进行排序操作。

list 的 sort 方法返回的是对已经存在的列表进行操作，无返回值，而内建函数 sorted 方法返回的是一个新的 list，而不是在原来的基础上进行的操作。

```
>>>a = [5,7,6,3,4,1,2]
>>> b = sorted(a) # 保留原列表
>>> a [5, 7, 6, 3, 4, 1, 2]
>>> b [1, 2, 3, 4, 5, 6, 7]
>>> L=[('b',2),('a',1),('c',3),('d',4)]
>>> sorted(L, cmp=lambda x,y:cmp(x[1],y[1])) # 利用cmp函数
[('a', 1), ('b', 2), ('c', 3), ('d', 4)]
>>> sorted(L, key=lambda x:x[1]) # 利用key
[('a', 1), ('b', 2), ('c', 3), ('d', 4)]
>>> students = [('john', 'A', 15), ('jane', 'B', 12), ('dave',
'B', 10)]
>>> sorted(students, key=lambda s: s[2]) # 按年龄排序
[('dave', 'B', 10), ('jane', 'B', 12), ('john', 'A', 15)]
>>> sorted(students, key=lambda s: s[2], reverse=True) # 按降序
[('john', 'A', 15), ('jane', 'B', 12), ('dave', 'B', 10)]
```

>>> print ('\n'.join(sorted(r,key = int)))
有的时候可能不对，加一个int 排序
=====
==

## Python format()

用法：

它通过{}和:来代替传统%方式

### 1、使用位置参数

要点：从以下例子可以看出位置参数不受顺序约束，且可以为{}，只要format里有相对应的参数值即可，参数索引从0开，传入位置参数列表可用\*列表

```
>>> li = ['hoho',18]
>>> 'my name is {} ,age {}'.format('hoho',18)
'my name is hoho ,age 18'
>>> 'my name is {1} ,age {0}'.format(10,'hoho')
'my name is hoho ,age 10'
>>> 'my name is {1} ,age {0} {1}'.format(10,'hoho')
'my name is hoho ,age 10 hoho'
>>> 'my name is {} ,age {}'.format(*li)
'my name is hoho ,age 18'
```

## 2、使用关键字参数

要点：关键字参数值要对得上，可用字典当关键字参数传入值，字典前加\*\*即可

```
>>> hash = {'name':'hoho', 'age':18}
>>> 'my name is {name}, age is {age}'.format(name='hoho', age=19)
'my name is hoho, age is 19'
>>> 'my name is {name}, age is {age}'.format(**hash)
'my name is hoho, age is 18'
```

## 3、填充与格式化

:[填充字符][对齐方式 <^>][宽度]

```
>>> '{0:>10}'.format(10)    ##右对齐
'*****10'
>>> '{0:<10}'.format(10)    ##左对齐
'10*****'
>>> '{0:^10}'.format(10)    ##居中对齐
'****10****'
```

## 4、精度与进制

```
>>> '{0:.2f}'.format(1/3)
'0.33'
>>> '{0:b}'.format(10)      ##二进制
'1010'
>>> '{0:o}'.format(10)      ##八进制
'12'
>>> '{0:x}'.format(10)      ##16进制
'a'
>>> '{:,}'.format(12369132698)  #千分位格式化
'12,369,132,698'
```

## 5、使用索引

```
>>> li
['hoho', 18]
>>> 'name is {0[0]} age is {0[1]}'.format(li)
'name is hoho age is 18
print("{} H, {} M".format(h,m))
=====
eval() 函数用来执行一个字符串表达式，并返回表达式的值。
>>>x = 7
Python math 模块提供了许多对浮点数的数学运算函数。 
Python cmath 模块包含了一些用于复数运算的函数。
cmath 模块的函数跟 math 模块函数基本一致，区别是 cmath 模块运算的是复数， math 模块运算的是数学运算。
要使用 math 或 cmath 函数必须先导入：
>>> eval('3 * x')
21
>>> eval('pow(2,2)')
4
>>> eval('2 + 2')
4
>>> n=81
>>> eval("n + 4")
85
=====
```

Python math 模块提供了许多对浮点数的数学运算函数。  
 Python cmath 模块包含了一些用于复数运算的函数。  
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要使用 math 或 cmath 函数必须先导入：

### Input Format

A single line containing the complex number. Note: complex() function can be used in python to convert the input as a complex number.

### Constraints

Given number is a valid complex number

### Output Format

Output two lines:

The first line should contain the value of .

The second line should contain the value of.

### Sample Input

```
1+2j
```

### Sample Output

```
2.23606797749979
1.1071487177940904
```

Note: The output should be correct up to 3 decimal places.

```
import cmath
if __name__ == '__main__':
    r = complex(input())
    print(cmath.polar(r)[0])
    print(cmath.polar(r)[1])
```

```
=====
```

### Python2:

raw\_input 直接读取控制台的输入  
input()读取一个合法的Python表达式

### 字符串的逆置：

```
print(s)
s=s[::-1]
print(s)
```

Python 有两种除法操作符，一种是单斜杠：用于传统除法，另一种双斜杠：  
用于浮点数除法，其结果进行四舍五入。

### Python字符串格式化：

Python 支持格式化字符串的输出。尽管这样可能会用到非常复杂的表达式，  
但最基本的用法是将一个值插入到一个有字符串格式符 %s 的字符串中。

```
print "My name is %s and weight is %d kg!" % ('Zara', 21)
```

Python单引号，双引号和三引号的区别：  
表示字符串是不是单引号和双引号都可以

### Python 多行输出：

```
print("""
so this is an
multi-line
print,pretty cool

""")
```

输入三个整数x,y,z，请把这三个数由小到大输出。

```
l=[]
for i in range(3):
    x= raw_input('Integer:\n')
    l.append(x)
l.sort()
print l
```

### 将一个列表中的数据复制到另一个列表中

```
import copy
a=[1,2,3]
b=copy.copy(a)
print(b)
```

```
l=[1,2,3,4]
```

```
p=[]
for i in range(len(l)):
    p.append(l[i])
print(p)
```

斐波那契数列：

```
def fib(n):
    a,b=1,1
    for i in range(n-1):
        a,b=b,a+b
    return a
print(fib(10))
```

**read()**每次读取整个文件

**readlines()**自动将文件内容分析成一个个行的列表

**readline()**每次只读取一行，速度比**readlines()**慢很多

python语言最常见的括号有三种，分别是：小括号()、中括号[]和大括号{}。其作用也各不相同，分别用来代表不同的python基本内置数据类型。

1、python中的小括号()：代表tuple元组数据类型，元组是一种不可变序列。创建方法很简单，大多时候都是用小括号括起来的。

```
1
2
3
4
5
6
7
8
9
>>> tup = (1,2,3)
>>> tup
(1, 2, 3)
>>>
>>> ()#空元组
()
>>>
>>> 55,#一个值的元组
(55,)
```

2、python中的中括号[]：代表list列表数据类型，列表是一种可变的序列。其创建方法即简单又特别，像下面一样：

```
1
2
>>> list('python')
['p', 'y', 't', 'h', 'o', 'n']
```

3、python大括号{}花括号：代表dict字典数据类型，字典是由键对值组成。冒号':'分开键和值，逗号','隔开组。用大括号创建的方法如下：

```
1
2
3
4
```

```
>>> dic={'jon':'boy','lili':'girl'}  
>>> dic  
{'lili': 'girl', 'jon': 'boy'}
```

总结：花括号是字典，中括号是列表，小括号是元组

# Numpy

2018年10月23日 星期二 09:51

C = A \* B 代替一个个数组里的元素相乘



```
import numpy as np
a = np.array([[1,2], [3, 4], [5, 6]])
# An example of integer array indexing.
# The returned array will have shape (3,) and
print(a[[0, 1, 2], [0, 1, 0]]) # Prints "[1 4 5]"
# The above example of integer array indexing is equivalent to this:
print(np.array([a[0, 0], a[1, 1], a[2, 0]])) # Prints "[1 4 5]"
# When using integer array indexing, you can reuse the same
# element from the source array:
print(a[[0, 0], [1, 1]]) # Prints "[2 2]"
# Equivalent to the previous integer array indexing example
print(np.array([a[0, 1], a[0, 1]])) # Prints "[2 2]"
```

python 的sum函数axis=0和axis=1

没有axis参数表示全部相加， axis = 0表示按列相加， axis = 1表示按照行的方向相加

加入axis=1就是将每一个矩阵的每一行向量相加

numpy的random模块：

```
>>> np.random.rand(3,2)
array([[ 0.14022471,  0.96360618], #random
       [ 0.37601032,  0.25528411], #random
       [ 0.49313049,  0.94909878]]) #random
```

Numpy.array() is used to convert a list into into a NumPy array.

```
import numpy as np
# Create a new array from which we will select elements
a = np.array([[1,2,3], [4,5,6], [7,8,9], [10, 11, 12]])
print(a) # prints "array([[1, 2, 3],
#                  [4, 5, 6],
#                  [7, 8, 9],
#                  [10, 11, 12]])"
# Create an array of indices
b = np.array([0, 2, 0, 1])
# Select one element from each row of a using the indices in b
print(a[np.arange(4), b]) # Prints "[1 6 7 11]"
# Mutate one element from each row of a using the indices in b
a[np.arange(4), b] += 10
print(a) # prints "array([[11, 2, 3],
#                  [4, 5, 16],
#                  [17, 8, 9],
#                  [10, 21, 12]])"
```



★ import numpy as np

```
x = np.array([[1,2],[3,4]])
print(np.sum(x)) # Compute sum of all elements; prints "10"
print(np.sum(x, axis=0)) # Compute sum of each column; prints "[4 6]"
print(np.sum(x, axis=1)) # Compute sum of each row; prints "[3 7]"
```

import numpy as np

np.sum(0,1,2],[2,1,3, axis = 1)

输出 array([3,6])

```
C = np.array([[0,2,1],[3,5,6],[0,1,1]])
print C.sum()
Print C.sum(axis = 0)
Print C.sum(axis = 1)
结果计算分别是: 19, [3,8,8], [3,14,2]
```

~~Axis = 0 按照行求和~~  
~~Axis = 1 按照列求和~~



Numpy.tile([0,0] , 5) # 在列方向上重复[0,0]5次, 只有1行  
Numpy.tile ([0,0),(1,3))

```
>>> a = np.array([0, 1, 2])
>>> np.tile(a, 2)
array([0, 1, 2, 0, 1, 2])
>>> np.tile(a, (2, 2))
array([[0, 1, 2, 0, 1, 2],
       [0, 1, 2, 0, 1, 2]])
>>> np.tile(a, (2, 1, 2))
array([[[0, 1, 2, 0, 1, 2]],
       [[0, 1, 2, 0, 1, 2]]])

>>>
>>> b = np.array([[1, 2], [3, 4]])
>>> np.tile(b, 2)
array([[1, 2, 1, 2],
       [3, 4, 3, 4]])
>>> np.tile(b, (2, 1)) #行数扩展为2倍, 列数不变
array([[1, 2],
       [3, 4],
       [1, 2],
       [3, 4]])

>>>
>>> c = np.array([1,2,3,4])
>>> np.tile(c,(4,1))
array([[1, 2, 3, 4],
       [1, 2, 3, 4],
       [1, 2, 3, 4],
       [1, 2, 3, 4]])
```

### ★ Numpy 中数字反过来, 有两种方式:

一种是 np.flipud(A)

另一种是

def arrays(arr):

```
#reverse array first, convert to float array with numpy
return (numpy.array(arr[::-1], float))
```

### ★ Sample Input

```
2 2
1 2
3 4
```

### Sample Output

```
[1 3]
[2 4]
[1 2 3 4]
```

```
import numpy
n, m = map(int, input().split())
array = numpy.array([input().strip().split() for _ in range(n)], int)
print(numpy.transpose(array)) # transpose()得到矩阵的倒置
print(array.flatten()) # 把这个矩阵铺平下来
```

## ★ 用numpy连接数组

Two or more arrays can be concatenated together using the *concatenate* function with a tuple of the arrays to be joined:

```
import numpy

array_1 = numpy.array([1,2,3])
array_2 = numpy.array([4,5,6])
array_3 = numpy.array([7,8,9])

print numpy.concatenate((array_1, array_2, array_3))
```

#Output  
[1 2 3 4 5 6 7 8 9]

If an array has more than one dimension, it is possible to specify the axis along which multiple arrays are concatenated. By default, it is along the first dimension.

```
import numpy

array_1 = numpy.array([[1,2,3],[0,0,0]])
array_2 = numpy.array([[0,0,0],[7,8,9]])

print numpy.concatenate((array_1, array_2), axis = 1) # axis =1 代表行方向
```

#Output  
[[1 2 3 0 0 0]  
 [0 0 0 7 8 9]]

## ★ 用numpy表示全0或者全1

**Sample Input 0**  
3 3 3

**Sample Output 0**  
[[[0 0 0]  
 [0 0 0]  
 [0 0 0]]]

[[0 0 0]  
 [0 0 0]  
 [0 0 0]]]

[[0 0 0]  
 [0 0 0]  
 [0 0 0]]]  
[[[1 1 1]  
 [1 1 1]  
 [1 1 1]]]

[[1 1 1]  
 [1 1 1]  
 [1 1 1]]]

[[1 1 1]  
 [1 1 1]]]

```
[1 1 1]]]
```

### Explanation 0

Print the array built using numpy.zeros and numpy.ones tools and you get the result as shown.

转化为tuple因为numpy.zeros( )只能处理元组类型

```
import numpy
nums = tuple(map(int, input().split())) #输入的个数不一定的时候使用
print(numpy.zeros(nums, dtype = numpy.int))
print(numpy.ones(nums, dtype = numpy.int))
```

## ★ dot

The *dot* tool returns the dot product of two arrays.

```
import numpy
```

```
A = numpy.array([ 1, 2 ])
B = numpy.array([ 3, 4 ])
```

```
print numpy.dot(A, B)    #Output : 11
```

## cross

The *cross* tool returns the cross product of two arrays.

```
import numpy
```

```
A = numpy.array([ 1, 2 ])
B = numpy.array([ 3, 4 ])
```

```
print numpy.cross(A, B)   #Output : -2
```

```
>>> b' spacious '.strip()
b'spacious'
>>> b'www.example.com'.strip(b'cmowz.')
b'example'
```



## 1.Python Find a string

---

In this challenge, the user enters a string and a substring. You have to print the number of times that the substring occurs in the given string. String traversal will take place from left to right, not from right to left.

NOTE: String letters are case-sensitive.

### Input Format

The first line of input contains the original string. The next line contains the substring.

### Constraints

Each character in the string is an ascii character.

### Output Format

Output the integer number indicating the total number of occurrences of the substring in the original string.

### Sample Input

```
1 ABCDCDC
2 CDC
```

### Sample Output

2

### Concept

Some string processing examples, [such as these](#), might be useful.

There are a couple of new concepts:

In Python, the length of a string is found by the function `len(s)`, where `s` is the string.

To traverse through the length of a string, use a for loop:

```
1 for i in range(0, len(s)):
2     print (s[i])
```

A range function is used to loop over some length:

```
1 range (0, 5)
```

Here, the range loops over to . is excluded.



**Python `strip()` 函数用于移除字符串头尾指定的字符（默认为空格或换行符）或字符序列。正常`strip()`指的是移除空格。**

```
1 def count_substring(string, sub_string):
2     count=0
3     for i in range(0, len(string)-len(sub_string)+1):
4         if string[i] == sub_string[0]:
5             flag=1
6             for j in range (0, len(sub_string)):
7                 if string[i+j] != sub_string[j]:
8                     flag=0
9                     break
10                if flag==1:
11                    count += 1
12    return count
13
14
15 if __name__ == '__main__':
16     string = input().strip()
17     sub_string = input().strip()
18
19     count = count_substring(string, sub_string)
20     print(count)
```

## 2.Python Merge the Tools

---

Consider the following:

- A string,  $s$ , of length  $n$  where  $s = c_0c_1 \dots c_{n-1}$ .
- An integer,  $k$ , where  $k$  is a factor of  $n$ .

We can split  $s$  into  $\frac{n}{k}$  subsegments where each subsegment,  $t_i$ , consists of a contiguous block of  $k$  characters in  $s$ . Then, use each  $t_i$  to create string  $u_i$  such that:

- The characters in  $u_i$  are a subsequence of the characters in  $t_i$ .
- Any repeat occurrence of a character is removed from the string such that each character in  $u_i$  occurs exactly once. In other words, if the character at some index  $j$  in  $t_i$  occurs at a previous index  $< j$  in  $t_i$ , then do not include the character in string  $u_i$ .

Given  $s$  and  $k$ , print  $\frac{n}{k}$  lines where each line  $i$  denotes string  $u_i$ .

### Input Format

The first line contains a single string denoting  $s$ .

The second line contains an integer,  $k$ , denoting the length of each subsegment.

### Constraints

- $1 \leq n \leq 10^4$ , where  $n$  is the length of  $s$
- $1 \leq k \leq n$
- It is guaranteed that  $n$  is a multiple of  $k$ .

### Output Format

Print  $\frac{n}{k}$  lines where each line  $i$  contains string  $u_i$ .

**zip()** 函数用于将可迭代的对象作为参数，将对象中对应的元素打包成一个个元组，然后返回由这些元组组成的对象，这样做的好处是节约了不少的内存。



```
1  
2 >>>a = [1,2,3]  
3 >>>b = [4,5,6]  
4 >>>c = [4,5,6,7,8]  
5 >>>zipped = zip(a,b)      # 返回一个对象  
6 >>>zipped  
7 <zip object at 0x103abc288>
```

```
8 >>> list(zipped) # list() 转换为列表
9 [(1, 4), (2, 5), (3, 6)]
10 >>> list(zip(a,c)) # 元素个数与最短的列表一致
11 [(1, 4), (2, 5), (3, 6)]
12
13 >>> a1, a2 = zip(*zip(a,b)) # 与 zip 相反, zip(*) 可理解为解压, 返回
14 二维矩阵式
15 >>> list(a1)
16 [1, 2, 3]
17 >>> list(a2)
18 [4, 5, 6]
19 >>>
```

# 以下实例展示了setdefault()方法的使用方法

```
#!/usr/bin/python3

dict = {'Name': 'Runoob', 'Age': 7}

print ("Age 键的值为 : %s" % dict.setdefault('Age', None))
print ("Sex 键的值为 : %s" % dict.setdefault('Sex', None))
print ("新字典为: ", dict)
```

Age 键的值为 : 7  
Sex 键的值为 : None  
新字典为: {'Age': 7, 'Name': 'Runoob', 'Sex': None}

### Sample Input

```
AABCAAADA
3
```

### Sample Output

```
AB
CA
AD
```

### Explanation

String  $s$  is split into  $\frac{n}{k} = \frac{9}{3} = 3$  equal parts of length  $k = 3$ . We convert each  $t_i$  to  $u_i$  by removing any subsequent occurrences non-distinct characters in  $t_i$ :

1.  $t_0 = "AAB" \rightarrow u_0 = "AB"$

2.  $t_1 = "CAA" \rightarrow u_1 = "CA"$

3.  $t_2 = "ADA" \rightarrow u_2 = "AD"$

We then print each  $u_i$  on a new line.



```
1 # dict() 使用方法
2 >>>dict()                                # 创建空字典
3 {}
4 >>> dict(a='a', b='b', t='t')      # 传入关键字
5 {'a': 'a', 'b': 'b', 't': 't'}
6 >>> dict(zip(['one', 'two', 'three'], [1, 2, 3]))    # 映射函数方式来构造字典
7 {'three': 3, 'two': 2, 'one': 1}
8 >>> dict([('one', 1), ('two', 2), ('three', 3)])    # 可迭代对象方式来构造字典
9 {'three': 3, 'two': 2, 'one': 1}
10 >>>
```

```
1 def merge_the_tools(string, k):
2     #S = input()
3     #N = int(input())
4     for part in zip(*[iter(string)] * k):
5         d = dict()
6         print(''.join([d.setdefault(c, c) for c in part if c not in d]))
7
8
9 if __name__ == '__main__':
10     string, k = input(), int(input())
11     merge_the_tools(string, k)
```

### 3.Python Nested Lists

---

Given the names and grades for each student in a Physics class of students, store them in a nested list and print the name(s) of any student(s) having the second lowest grade.

Note: If there are multiple students with the same grade, order their names alphabetically and print each name on a new line.

#### Input Format

The first line contains an integer, , the number of students.

The subsequent lines describe each student over lines; the first line contains a student's name, and the second line contains their grade.

#### Constraints

There will always be one or more students having the second lowest grade.

#### Output Format

Print the name(s) of any student(s) having the second lowest grade in Physics; if there are multiple students, order their names alphabetically and print each one on a new line.

## Sample Input 0

```
5
Harry
37.21
Berry
37.21
Tina
37.2
Akriti
41
Harsh
39
```

## Sample Output 0

```
Berry
Harry
```

## Explanation 0

There are students in this class whose names and grades are assembled to build the following list:

```
python students = [['Harry', 37.21], ['Berry', 37.21], ['Tina', 37.2], ['Akriti', 41], ['Harsh', 39]]
```

The lowest grade of belongs to Tina. The second lowest grade of belongs to both Harry and Berry, so we

order their names alphabetically and print each name on a new line.

```
1 if __name__ == '__main__':
2     marksheet = []
3     for _ in range(int(input())):
4         name = input()
5         score = float(input())
6         #marksheet = []
7         marksheet.append([name,score])
8     second_highest = sorted(list(set([marks for name, marks in marksheet])))
9     [1] # set very important because we want to find the second largest
10    print('\n'.join([a for a,b in sorted(marksheet) if b == second_highest]))
11
```

## 4. Python String Formatting

---

Given an integer,  $n$ , print the following values for each integer  $i$  from  $1$  to  $n$ :

1. Decimal
2. Octal
3. Hexadecimal (capitalized)
4. Binary

The four values must be printed on a single line in the order specified above for each  $i$  from  $1$  to  $n$ . Each value should be space-padded to match the width of the binary value of  $n$ .

### Input Format

A single integer denoting  $n$ .

### Constraints

- $1 \leq n \leq 99$

### Output Format

Print  $n$  lines where each line  $i$  (in the range  $1 \leq i \leq n$ ) contains the respective decimal, octal, capitalized hexadecimal, and binary values of  $i$ . Each printed value must be formatted to the width of the binary value of  $n$

### Sample Input

```
1 17
```

### Sample Output

1	1	1	1	1
2	2	2	2	10
3	3	3	3	11
4	4	4	4	100
5	5	5	5	101
6	6	6	6	110
7	7	7	7	111
8	8	10	8	1000
9	9	11	9	1001
10	10	12	A	1010
11	11	13	B	1011
12	12	14	C	1100

```
13    13    15      D  1101
14    14    16      E  1110
15    15    17      F  1111
16    16    20      10 10000
17    17    21      11 10001
```

**format() 函数的使用，str.format()**，是一种格式化字符串的函数，增强了字符串格式化功能。基本语法是通过 {} 和 : 来代替以前的 %。

```
1 >>> "{} {}".format("hello", "world")      # 不设置指定位置，按默认顺序
2 'hello world'
3
4 >>> "{0} {1}".format("hello", "world")   # 设置指定位置
5 'hello world'
6
7 >>> "{1} {0} {1}".format("hello", "world") # 设置指定位置
8 'world hello world'
```

```
1 >>> print("{:.2f}".format(3.1415926)); # str.format() 格式化数字的多种方法：
2 3.14
3 >>> "The sum of 1 + 2 is {}".format(1+2)
4 'The sum of 1 + 2 is 3'
```

```
1 #!/usr/bin/python
2 # -*- coding: UTF-8 -*-
3
4 print("网站名：{name}, 地址 {url}".format(name="菜鸟教程",
5                                         url="www.runoob.com"))
6
7 # 通过字典设置参数
8 site = {"name": "菜鸟教程", "url": "www.runoob.com"}
9 print("网站名：{name}, 地址 {url}".format(**site))
10
11 # 通过列表索引设置参数
12 my_list = ['菜鸟教程', 'www.runoob.com']
13 print("网站名：{0[0]}, 地址 {0[1]}".format(my_list)) # "0" 是必须的
```

```
1 def print_formatted(number):
2     width = len("{0:b}".format(number))
3     for i in range(1, number+1):
4         print ("{0:{width}d} {0:{width}o} {0:{width}X} {0:
5 {width}b}".format(i, width=width))
6
7     # here "0" represents that this string starts from the beginning for each line
8
9 if __name__ == '__main__':
10    n = int(input())
11    print_formatted(n)
```

## 5. Python Set.discard(), .remove()&.pop()

---

### .remove(x)

This operation removes element  $x$  from the set.

If element  $x$  does not exist, it raises a KeyError.

The .remove(x) operation returns None.

#### Example

```
>>> s = set([1, 2, 3, 4, 5, 6, 7, 8, 9])
>>> s.remove(5)
>>> print s
set([1, 2, 3, 4, 6, 7, 8, 9])
>>> print s.remove(4)
None
>>> print s
set([1, 2, 3, 6, 7, 8, 9])
>>> s.remove(0)
KeyError: 0
```

### .discard(x)

This operation also removes element  $x$  from the set.

If element  $x$  does not exist, it **does not** raise a KeyError.

The .discard(x) operation returns None.

#### Example

```
>>> s = set([1, 2, 3, 4, 5, 6, 7, 8, 9])
>>> s.discard(5)
>>> print s
set([1, 2, 3, 4, 6, 7, 8, 9])
>>> print s.discard(4)
None
>>> print s
set([1, 2, 3, 6, 7, 8, 9])
>>> s.discard(0)
>>> print s
set([1, 2, 3, 6, 7, 8, 9])
```

## .pop()

This operation removes and return an arbitrary element from the set.

If there are no elements to remove, it raises a `KeyError`.

### Example

```
>>> s = set([1])
>>> print s.pop()
1
>>> print s
set(())
>>> print s.pop()
KeyError: pop from an empty set
```

## Task

You have a non-empty set  $s$ , and you have to execute  $N$  commands given in  $N$  lines.

The commands will be `pop`, `remove` and `discard`.

### Input Format

The first line contains integer  $n$ , the number of elements in the set  $s$ .

The second line contains  $n$  space separated elements of set  $s$ . All of the elements are non-negative integers, less than or equal to 9.

The third line contains integer  $N$ , the number of commands.

The next  $N$  lines contains either `pop`, `remove` and/or `discard` commands followed by their associated value.

### Constraints

$0 < n < 20$

$0 < N < 20$

### Output Format

Print the sum of the elements of set  $s$  on a single line.

### Sample Input

```
9
1 2 3 4 5 6 7 8 9
10
pop
remove 9
discard 9
```

```
discard 8
remove 7
pop
discard 6
remove 5
pop
discard 5
```

## Sample Output

```
4
```

## Explanation

After completing these **10** operations on the set, we get  $\text{set}([4])$ . Hence, the sum is **4**.

**Note:** Convert the elements of set s to integers while you are assigning them. To ensure the proper input of the set, we have added the first two lines of code to the editor.

## 解法一

```
1 n = int(input())
2
3 s = set(map(int, input().split()))
4
5 for i in range(int(input())):
6
7     eval('s.{0}({1})'.format(*input().split()+[']))# it means like s.remove(9)
8
9 print(sum(s))
```

解释: eval() 函数用来执行一个字符串表达式，并返回表达式的值。

```
>>>x = 7
>>> eval('3 * x')
21
>>> eval('pow(2,2)')
4
>>> eval('2 + 2')
4
>>> n=81
>>> eval("n + 4")
85
```

## 解法二

```
1 n = int(raw_input())
2 s = set([int(x) for x in raw_input().strip().split()]) # strip() can be added or not add
   ed, both OK
3 for _ in range(int(raw_input())):
4
5     a = list(raw_input().strip().split())
6
7     if a[0] == 'pop':
8         s.pop()
9     elif a[0] == 'discard':
10        s.discard(int(a[1]))
11    else:
12        s.remove(int(a[1]))
13
14 print sum(s)
```

## 6.Python Text Wrap

---

You are given a string and width .

Your task is to wrap the string into a paragraph of width .

### Input Format

The first line contains a string, .

The second line contains the width, .

### Sample Input 0

```
1 ABCDEFGHIJKLMNOPQRSTUVWXYZ
2 4
```

### Sample Output 0

```
1 ABCD
2 EFGH
3 IJKL
4 IMNO
5 QRST
6 UVWX
7 YZ
```

值得注意的还是 `join()` 函数的使用，挺方便的，用这种形式来实现换行\n

还有留意这里 `range()` 的使用，使用了3个参数



```
1 import textwrap
2
3 def wrap(string, max_width):
4     return "\n".join(string[i:i+max_width] for i in range(0, len(string), max_width))
5
6 if __name__ == '__main__':
7     string, max_width = input(), int(input())
8     result = wrap(string, max_width)
9     print(result)
```

## 7. Python Set Mutations

---

We have seen the applications of union, intersection, difference and symmetric difference operations, but these operations do not make any changes or mutations to the set.

**We can use the following operations to create mutations to a set:**

**.update() or |=**

Update the set by adding elements from an iterable/another set.

```
>>> H = set("Hacker")
>>> R = set("Rank")
>>> H.update(R)
>>> print H
set(['a', 'c', 'e', 'H', 'k', 'n', 'r', 'R'])
```

**.intersection\_update() or &=**

Update the set by keeping only the elements found in it and an iterable/another set.

```
>>> H = set("Hacker")
>>> R = set("Rank")
>>> H.intersection_update(R)
>>> print H
set(['a', 'k'])
```

**.difference\_update() or -=**

Update the set by removing elements found in an iterable/another set.

```
>>> H = set("Hacker")
>>> R = set("Rank")
>>> H.difference_update(R)
>>> print H
set(['c', 'e', 'H', 'r'])
```

**.symmetric\_difference\_update() or ^=**

Update the set by only keeping the elements found in either set, but not in both.

```
>>> H = set("Hacker")
>>> R = set("Rank")
```

```
>>> H.symmetric_difference_update(R)
>>> print H
set(['c', 'e', 'H', 'n', 'r', 'R'])
```

## TASK

You are given a set  $A$  and  $N$  number of other sets. These  $N$  number of sets have to perform some specific mutation operations on set  $A$ .

Your task is to execute those operations and print the sum of elements from set  $A$ .

### Input Format

The first line contains the number of elements in set  $A$ .

The second line contains the space separated list of elements in set  $A$ .

The third line contains integer  $N$ , the number of other sets.

The next  $2 * N$  lines are divided into  $N$  parts containing two lines each.

The first line of each part contains the space separated entries of the operation name and the length of the other set.

The second line of each part contains space separated list of elements in the other set.

$0 < \text{len}(\text{set}(A)) < 1000$

$0 < \text{len}(\text{otherSets}) < 100$

$0 < N < 100$

### Output Format

Output the sum of elements in set  $A$ .

### Sample Input

```
16
12345678910111213142452
4
intersection_update 10
23568914711
update2
5566
symmetric_difference_update 5
227356258
difference_update 7
11223555586266
```

### Sample Output

## Explanation

After the first operation, (intersection\_update operation), we get:

`set A = set([1, 2, 3, 4, 5, 6, 7, 8, 9, 11])`

After the second operation, (update operation), we get:

`set A = set([1, 2, 3, 4, 5, 6, 7, 8, 9, 11, 55, 66])`

After the third operation, (symmetric\_difference\_update operation), we get:

`set A = set([1, 2, 3, 4, 5, 6, 8, 9, 11, 22, 35, 55, 58, 62, 66])`

After the fourth operation, ( difference\_update operation), we get:

`set A = set([1, 2, 3, 4, 5, 6, 8, 9])`

The sum of elements in set  $A$  after these operations is **38**.

`eval()`函数用来执行一个字符串表达式，并返回表达式的值。

```
>>>x = 7
>>> eval('3 * x')
21
>>> eval('pow(2,2)')
4
>>> eval('2 + 2')
4
>>> n=81
>>> eval("n + 4")
85
```

```
1 # Enter your code here. Read input from STDIN. Print output to STDOUT
2 if __name__ == '__main__':
3     m = int(input())
4     A = set(map(int, input().split()))# After map operation, it turns out to be a vector
5     n = int(input())
6
7     for i in range(n):
8         cmd, args = input().split() #args not need in this code
9         B = set(map(int, input().split()))
10        eval('A.'+cmd+'(B)')
11
12    print (sum(A))
```

## 8. Python Triangle Quest 2

You are given a positive integer  $N$ .

Your task is to print a palindromic triangle of size  $N$ .

For example, a palindromic triangle of size 5 is:

```
1
121
12321
1234321
123454321
```

You can't take more than two lines. The first line (a for-statement) is already written for you.

You have to complete the code using exactly one print statement.

Note:

Using anything related to strings will give a score of 0.

Using more than one for-statement will give a score of 0.

Input Format

A single line of input containing the integer  $N$ .

Constraints

- $0 < N < 10$

Output Format

Print the palindromic triangle of size  $N$  as explained above.

Sample Input

```
5
```

Sample Output

```
1
121
12321
1234321
123454321
```

list 直接输出来是矩阵，所以这里加一个 \* 号，代表输出里面的数字



```
1 for i in range(0,int(input())):
2     #print ([1, 121, 12321, 1234321, 123454321, 12345654321, 1234567654321, 123456787654321, 12345678987654321, 123456
78910987654321][i])
3     print(*(list(range(1, i)) + list(range(i, 0, -1))), sep="")
```

## 9. Python Integers Come In All Sizes

---

Integers in Python can be as big as the bytes in your machine's memory. There is no limit in size as there is:  $2^{31} - 1$  (c++ int) or  $2^{63} - 1$  (C++ long long int).

As we know, the result of  $a^b$  grows really fast with increasing  $b$ .

Let's do some calculations on very large integers.

### Task

Read four numbers,  $a$ ,  $b$ ,  $c$ , and  $d$ , and print the result of  $a^b + c^d$ .

### Input Format

Integers  $a$ ,  $b$ ,  $c$ , and  $d$  are given on four separate lines, respectively.

### Constraints

$$1 \leq a \leq 1000$$

$$1 \leq b \leq 1000$$

$$1 \leq c \leq 1000$$

$$1 \leq d \leq 1000$$

### Output Format

Print the result of  $a^b + c^d$  on one line.

### Sample Input

```
9
29
7
27
```

### Sample Output

```
4710194409608608369201743232
```

Note: This result is bigger than  $2^{63} - 1$ . Hence, it won't fit in the long long int of C++ or a 64-bit integer.

**Python中用pow()函数，不受数位的限制，可以研究下相关的源码**

```
1 # Enter your code here. Read input from STDIN. Print output to STDOUT
```

```
2 if __name__== '__main__':
3     a=int(input())
4     b=int(input())
5     c=int(input())
6     d=int(input())
7     e=pow(a,b)+pow(c,d)
8     print(e)
```

## 10. Python Numpy Polynomials

---

### poly

The poly tool returns the coefficients of a polynomial with the given sequence of roots.

```
print numpy.poly([-1, 1, 1, 10]) #Output:[ 1 -11  9 11 -10]
```

### roots

The roots tool returns the roots of a polynomial with the given coefficients.

```
print numpy.roots([1, 0, -1]) #Output:[-1.  1.]
```

### polyint

The polyint tool returns an antiderivative (indefinite integral) of a polynomial.

```
print numpy.polyint([1, 1, 1]) #Output:[0.33333333 0.5  1.  0.  ]
```

### polyder

The polyder tool returns the derivative of the specified order of a polynomial.

```
print numpy.polyder([1, 1, 1, 1]) #Output:[3 2 1]
```

### polyval

The polyval tool evaluates the polynomial at specific value.

```
print numpy.polyval([1, -2, 0, 2], 4) #Output:34
```

### polyfit

The polyfit tool fits a polynomial of a specified order to a set of data using a least-squares approach.

```
print numpy.polyfit([0,1,-1,2,-2],[0,1,1,4,4],2)
#Output:[ 1.0000000e+00  0.0000000e+00 -3.97205465e-16]
```

The functions `polyadd`, `polysub`, `polymul`, and `polydiv` also handle proper addition, subtraction, multiplication, and division of polynomial coefficients, respectively.

## Task

You are given the coefficients of a polynomial  $P$ .

Your task is to find the value of  $P$  at point  $x$ .

### Input Format

The first line contains the space separated value of the coefficients in  $P$ .

The second line contains the value of  $x$ .

### Output Format

Print the desired value.

### Sample Input

```
1.123
0
```

### Sample Output

```
3.0
```

```
1 import numpy as np
2 print(np.polyval(list(map(float,input().split())), int(input())))
3
```

## 11. Python Numpy Linear Algebra

---

The NumPy module also comes with a number of built-in routines for linear algebra calculations. These can be found in the sub-module linalg.

### linalg.det

The linalg.det tool computes the determinant of an array.

```
print numpy.linalg.det([[1 ,2],[2, 1]]) #Output:-3.0
```

### linalg.eig

The linalg.eig computes the eigenvalues and right eigenvectors of a square array.

```
vals, vecs = numpy.linalg.eig([[1 ,2],[2, 1]])
print vals          #Output:[3.-1.]
print vecs          #Output:[[0.70710678-0.70710678]
                      # [0.70710678 0.70710678]]
```

### linalg.inv

The linalg.inv tool computes the (multiplicative) inverse of a matrix.

```
print numpy.linalg.inv([[1 ,2],[2, 1]]) #Output: [[-0.33333333 0.66666667]
                                             # [0.66666667 -0.33333333]]
```

Other routines can be found [here](#)

---

### Task

You are given a square matrix  $A$  with dimensions  $N \times N$ . Your task is to find the determinant.

#### Input Format

The first line contains the integer  $N$ .

The next  $N$  lines contains the  $N$  space separated elements of array  $A$ .

#### Output Format

Print the determinant of  $A$ .

## Sample Input

```
2
1.1 1.1
1.1 1.1
```

## Sample Output

```
0.0
```

```
1 import numpy
2 m = int(input())
3 array = numpy.array([input().strip().split() for _ in range(m)],float)
4 numpy.set_printoptions(legacy='1.13') #important
5 print(numpy.linalg.det(array))
6
```

## 12.Python Built-ins Zipped!

`zip([iterable, ...])`



This function returns a list of tuples. The  $i^{\text{th}}$  tuple contains the  $i^{\text{th}}$  element from each of the argument sequences or iterables.

If the argument sequences are of unequal lengths, then the returned list is truncated to the length of the shortest argument sequence.

Sample Code

```
>>> print zip([1,2,3,4,5,6],'Hacker')
[(1,'H'),(2,'a'),(3,'c'),(4,'k'),(5,'e'),(6,'r')]
>>>
>>> print zip([1,2,3,4,5,6],[0,9,8,7,6,5,4,3,2,1])
[(1,0),(2,9),(3,8),(4,7),(5,6),(6,5)]
>>>
>>> A=[1,2,3]
>>> B=[6,5,4]
>>> C=[7,8,9]
>>> X=[A]+[B]+[C]
>>>
>>> print zip(*X)
[(1,6,7),(2,5,8),(3,4,9)]
```

### Task

The National University conducts an examination of  $N$  students in  $X$  subjects.

Your task is to compute the average scores of each student.

$$\text{Average score} = \frac{\text{Sum of scores obtained in all subjects by a student}}{\text{Total number of subjects}}$$

The format for the general mark sheet is:

Student ID →	1	2	3	4	5
Subject 1	89	90	78	93	80
Subject 2	90	91	85	88	86
Subject 3	91	92	83	89	90.5
	_____				
Average	90	91	82	90	85.5

### Input Format

The first line contains  $N$  and  $X$  separated by a space.

The next  $X$  lines contains the space separated marks obtained by students in a particular subject.

### Constraints

$$0 < N \leq 100$$

$$0 < X \leq 100$$

### Output Format

Print the averages of all students on separate lines.

The averages must be correct up to 1 decimal place.

### Sample Input

```
53
8990789380
9091858886
9192838990.5
```

#### Sample Output

```
90.0
91.0
82.0
90.0
85.5
```

#### Explanation

Marks obtained by student 1: **89, 90, 91**

Average marks of student 1:

$$270/3 = 90$$

Marks obtained by student 2: **90, 91, 92**

Average marks of student 2:

$$273/3 = 91$$

Marks obtained by student 3: **78, 85, 83**

Average marks of student 3:

$$246/3 = 82$$

Marks obtained by student 4: **93, 88, 89**

Average marks of student 4:

$$270/3 = 90$$

Marks obtained by student 5: **80, 86, 90.5**

Average marks of student 5:

$$256.5/3 = 85.5$$

```
1 # Enter your code here. Read input from STDIN. Print output to STDOUT
2 if __name__ == '__main__':
3     n,m = map(int, input().split())
4     sheet = []
5     for _ in range(m):
6         sheet.append(map(float, input().split()))
7
8     for i in zip(*sheet):
9         print(sum(i)/len(i))
```

## 13.Python Built-Ins Athlete Sort

---

You are given a spreadsheet that contains a list of  $N$  athletes and their details (such as age, height, weight and so on). You are required to sort the data based on the  $K^{\text{th}}$  attribute and print the final resulting table. Follow the example given below for better understanding.

Rank	Age	Height (in cm)	Rank	Age	Height (in cm)
1	32	190	5	24	176
2	35	175	4	26	195
3	41	188	1	32	190
4	26	195	2	35	175
5	24	176	3	41	188

Note that  $K$  is indexed from 0 to  $M - 1$ , where  $M$  is the number of attributes.

**Note:** If two attributes are the same for different rows, for example, if two athletes are of the same age, print the row that appeared first in the input.

### Input Format

The first line contains  $N$  and  $M$  separated by a space.

The next  $N$  lines each contain  $M$  elements.

The last line contains  $K$ .

### Constraints

$$1 \leq N, M \leq 1000$$

$$0 \leq K < M$$

$$\text{Each element } \leq 1000$$

### Output Format

Print the  $N$  lines of the sorted table. Each line should contain the space separated elements. Check the sample below for clarity.

### Sample Input 0

```
5 3
10 2 5
7 1 0
9 9 9
1 23 12
```

```
6 5 9
```

```
1
```

## Sample Output 0

```
7 1 0  
10 2 5  
6 5 9  
9 9 9  
1 2 3 1 2
```

## Explanation 0

The details are sorted based on the second attribute, since  $K$  is zero-indexed.

## Python lambda()函数

1、lambda是什么？

看个例子：

```
1 1 g = lambda x:x+1
```

看一下执行的结果：

```
g(1)
```

```
>>>2
```

```
g(2)
```

```
>>>3
```

当然，你也可以这样使用：

```
lambda x:x+1(1)
```

```
>>>2
```

可以这样认为，lambda作为一个表达式，定义了一个匿名函数，上例的代码x为入口参数， $x+1$ 为函数体，用函数来表示为：

```
1 1 def g(x):  
2 2     return x+1
```

非常容易理解，在这里lambda简化了函数定义的书写形式。是代码更为简洁，但是使用函数的定义方式更为

直观，易理解。

Python中，也有几个定义好的全局函数方便使用的，filter, map, reduce

```
1 >>> foo = [2, 18, 9, 22, 17, 24, 8, 12, 27]
2 >>>
3 >>> print filter(lambda x: x % 3 == 0, foo)
4 [18, 9, 24, 12, 27]
5 >>>
6 >>> print map(lambda x: x * 2 + 10, foo)
7 [14, 46, 28, 54, 44, 58, 26, 34, 64]
8 >>>
9 >>> print reduce(lambda x, y: x + y, foo)
10 139
```

上面例子中的map的作用，非常简单清晰。但是，Python是否非要使用lambda才能做到这样的简洁程度呢？在对象遍历处理方面，其实Python的for..in..if语法已经很强大，并且在易读上胜过了lambda。

比如上面map的例子，可以写成：

```
print [x * 2 + 10 for x in foo]
```

非常的简洁，易懂。

filter的例子可以写成：

```
print [x for x in foo if x % 3 == 0]
```

同样也是比lambda的方式更容易理解。

---

上面简要介绍了什么是lambda,下面介绍为什么使用lambda,看一个例子（来自apihelper.py）：

```
1 processFunc = collapse and (lambda s: " ".join(s.split())) or (lambda s: s
)
```

在Visual Basic，你很有可能要创建一个函数，接受一个字符串参数和一个 collapse 参数，并使用 if 语句确定是否压缩空白，然后再返回相应的值。这种方式是低效的，因为函数可能需要处理每一种可能的情况。每次你调用它，它将不得不在给出你所想要的东西之前，判断是否要压缩空白。在 Python 中，你可以将决策逻辑拿到函数外面，而定义一个裁减过的 lambda 函数提供确切的(唯一的)你想要的。这种方式更为高效、更为优雅，而且很少引起那些令人讨厌(哦，想到那些参数就头昏)的错误。

通过此例子，我们发现，lambda的使用大量简化了代码，使代码简练清晰。但是值得注意的是，这会在一定程度上降低代码的可读性。如果不是非常熟悉python的人或许会对此感到不可理解。

---

lambda 定义了一个匿名函数

lambda 并不会带来程序运行效率的提高，只会使代码更简洁。

如果可以使用for...in...if来完成的，坚决不用lambda。

如果使用lambda，lambda内不要包含循环，如果有，我宁愿定义函数来完成，使代码获得可重用性和更好的可读性。

总结：lambda 是为了减少单行函数的定义而存在的。

```
1 #!/bin/python
2 # Very excellent solution! Try more questions using lamda()
3 import math
4 import os
5 import random
6 import re
7 import sys
8
9 if __name__ == '__main__':
10     N, M = map(int, input().split())
11     rows = [input() for _ in range(N)]
12     K = int(input())
13
14     for row in sorted(rows, key=lambda row: int(row.split()[K])):
15         print(row)
```



## 14.Python Built-Ins Any or All

---

### any()

This expression returns True if **any** element of the iterable is true.

If the iterable is empty, it will return False.

#### Code

```
>>> any([1>0,1==0,1<0])
True
>>> any([1<0,2<1,3<2])
False
```

### all()

This expression returns True if **all** of the elements of the iterable are true. If the iterable is empty, it will return True.

#### Code

```
>>> all(['a'<'b','b'<'c'])
True
>>> all(['a'<'b','c'<'b'])
False
```

### Task

You are given a space separated list of integers. If all the integers are positive, then you need to check if any integer is a **palindromic integer**.

#### Input Format

The first line contains an integer  $N$ .  $N$  is the total number of integers in the list.

The second line contains the space separated list of  $N$  integers.

#### Constraints

$0 < N < 100$

#### Output Format

Print True if all the conditions of the problem statement are satisfied. Otherwise, print False.

### Sample Input

```
5
12961514
```

### Sample Output

True

### Explanation

**Condition 1:** All the integers in the list are positive.

**Condition 2:** 5 is a palindromic integer.

Hence, the output is True.

Can you solve this challenge in 3 lines of code or less?

There is no penalty for solutions that are correct but have more than 3 lines.

```
1 # Enter your code here. Read input from STDIN. Print output to STDOUT
2 if __name__ == '__main__':
3     i = int(input())
4     lis = map(int, input().split())
5     print ( all( v > 0 for v in lis) and any( str(v) == str(v)[::-1] for v in lis))
6     n = int(input())
7     arr = input().split(" ")
8     print(all(int(i)>=0 for i in arr) and any(i == i[::-1]for i in arr))
9
```

## 15. Python itertools.product()

Python的内建模块 `itertools` 提供了非常有用的用于操作迭代对象的函数。



首先，我们看看 `itertools` 提供的几个“无限”迭代器：

```
>>> import itertools
>>> naturals = itertools.count(1)
>>> for n in naturals:
...     print n
...
1
2
3
...
```

因为 `count()` 会创建一个无限的迭代器，所以上述代码会打印出自然数序列，根本停不下来，只能按 `Ctrl+C` 退出。

`cycle()` 会把传入的一个序列无限重复下去：

```
>>> import itertools
>>> cs = itertools.cycle('ABC') # 注意字符串也是序列的一种
>>> for c in cs:
...     print c
...
'A'
'B'
'C'
'A'
'B'
'C'
...
```

同样停不下来。

`repeat()` 负责把一个元素无限重复下去，不过如果提供第二个参数就可以限定重复次数：

```
>>> ns = itertools.repeat('A', 10)
>>> for n in ns:
...     print n
...
打印10次 'A'
```

无限序列只有在 `for` 迭代时才会无限地迭代下去，如果只是创建了一个迭代对象，它不会事先把无限个元素生成出来，事实上也不可能在内存中创建无限多个元素。

无限序列虽然可以无限迭代下去，但是通常我们会通过 `takewhile()` 等函数根据条件判断来截取出一个有限的序列：

```
>>> naturals = itertools.count(1)
>>> ns = itertools.takewhile(lambda x: x <= 10, naturals)
>>> for n in ns:
...     print n
...
打印出1到10
```

`itertools` 提供的几个迭代器操作函数更加有用：

## chain()

`chain()` 可以把一组迭代对象串联起来，形成一个更大的迭代器：

```
for c in itertools.chain('ABC', 'XYZ'):
    print c
# 迭代效果: 'A' 'B' 'C' 'X' 'Y' 'Z'
```

## groupby()

`groupby()` 把迭代器中相邻的重复元素挑出来放在一起：

```
>>> for key, group in itertools.groupby('AAABBBCCAAA'):
...     print key, list(group) # 为什么这里要用list()函数呢?
...
A ['A', 'A', 'A']
B ['B', 'B', 'B']
C ['C', 'C']
A ['A', 'A', 'A']
```

实际上挑选规则是通过函数完成的，只要作用于函数的两个元素返回的值相等，这两个元素就被认为是在一组的，而函数返回值作为组的key。如果我们要忽略大小写分组，就可以让元素 '`'A'`' 和 '`'a'`' 都返回相同的key：

```
>>> for key, group in itertools.groupby('AaaBBbcCAAA', lambda c: c.upper()):
...     print key, list(group)
...
A ['A', 'a', 'a']
B ['B', 'B', 'b']
C ['c', 'C']
A ['A', 'A', 'a']
```

## imap()

`imap()` 和 `map()` 的区别在于，`imap()` 可以作用于无穷序列，并且，如果两个序列的长度不一致，以短的那个为准。

```
>>> for x in itertools imap(lambda x, y: x * y, [10, 20, 30], itertools count(1)):  
...     print x  
...  
10  
40  
90
```

注意 `imap()` 返回一个迭代对象，而 `map()` 返回 `list`。当你调用 `map()` 时，已经计算完毕：

```
>>> r = map(lambda x: x*x, [1, 2, 3])  
>>> r # r已经计算出来了  
[1, 4, 9]
```

当你调用 `imap()` 时，并没有进行任何计算：

```
>>> r = itertools imap(lambda x: x*x, [1, 2, 3])  
>>> r  
<itertools.imap object at 0x103d3ff90>  
# r只是一个迭代对象
```

必须用 `for` 循环对 `r` 进行迭代，才会在每次循环过程中计算出下一个元素：

```
>>> for x in r:  
...     print x  
...  
1  
4  
9
```

这说明 `imap()` 实现了“惰性计算”，也就是在需要获得结果的时候才计算。类似 `imap()` 这样能够实现惰性计算的函数就可以处理无限序列：

```
>>> r = itertools imap(lambda x: x*x, itertools count(1))  
>>> for n in itertools takewhile(lambda x: x<100, r):  
...     print n  
...  
结果是什么？
```

如果把 `imap()` 换成 `map()` 去处理无限序列会有什么结果？

```
>>> r = map(lambda x: x*x, itertools count(1))  
结果是什么？
```

## ifilter()

不用多说了，`ifilter()` 就是 `filter()` 的惰性实现。

## 小结

`itertools` 模块提供的全部是处理迭代功能的函数，它们的返回值不是list，而是迭代对象，只有用`for`循环迭代的时候才真正计算。

### `itertools.product()`

This tool computes the **cartesian product** of input iterables.

It is equivalent to nested for-loops.

For example, `product(A, B)` returns the same as `((x,y) for x in A for y in B)`.

Sample Code

```
>>> from itertools import product
>>>
>>> print list(product([1,2,3],repeat=2))
[(1, 1), (1, 2), (1, 3), (2, 1), (2, 2), (2, 3), (3, 1), (3, 2), (3, 3)]
>>>
>>> print list(product([1,2,3],[3,4]))
[(1, 3), (1, 4), (2, 3), (2, 4), (3, 3), (3, 4)]
>>>
>>> A=[[1,2,3],[3,4,5]]
>>> print list(product(*A))
[(1, 3), (1, 4), (1, 5), (2, 3), (2, 4), (2, 5), (3, 3), (3, 4), (3, 5)]
>>>
>>> B=[[1,2,3],[3,4,5],[7,8]]
>>> print list(product(*B))
[(1, 3, 7), (1, 3, 8), (1, 4, 7), (1, 4, 8), (1, 5, 7), (1, 5, 8), (2, 3, 7), (2, 3, 8), (2, 4, 7), (2, 4, 8), (2, 5, 7), (2, 5, 8), (3, 3, 7), (3, 3, 8), (3, 4, 7), (3, 4, 8), (3, 5, 7), (3, 5, 8)]
```

## Task

You are given two lists  $A$  and  $B$ . Your task is to compute their cartesian product  $A \times B$ .

### Example

```
A=[1,2]
B=[3,4]

AxB=[(1,3),(1,4),(2,3),(2,4)]
```

Note:  $A$  and  $B$  are sorted lists, and the cartesian product's tuples should be output in sorted order.

### Input Format

The first line contains the space separated elements of list *A*.

The second line contains the space separated elements of list *B*.

Both lists have no duplicate integer elements.

#### Constraints

$0 < A < 30$

$0 < B < 30$

#### Output Format

Output the space separated tuples of the cartesian product.

#### Sample Input

```
12
```

```
34
```

#### Sample Output

```
(1, 3)(1, 4)(2, 3)(2, 4)
```

```
1 import itertools
2 if __name__ == '__main__':
3     A = list(map(int, input().split()))
4     B = list(map(int, input().split()))
5     #print(A*B) # can't multiply sequence by non-int of type 'list'
6     print(*itertools.product(A, B)) #(1, 3) (1, 4) (2, 3) (2, 4)
7
```

## 16. Python itertools.permutations

---

`itertools.permutations(iterator[, r])`

### 就是一共有多少种排列组合，都显示出来

This tool returns successive  $r$  length permutations of elements in an iterable.

If  $r$  is not specified or is `None`, then  $r$  defaults to the length of the iterable, and all possible full length permutations are generated.

Permutations are printed in a lexicographic sorted order. So, if the input iterable is sorted, the permutation tuples will be produced in a sorted order.

Sample Code

```
>>>from itertools import permutations
>>>print permutations(['1','2','3'])
<itertools.permutations object at 0x02A45210>
>>>
>>>print list(permutations(['1','2','3']))
[('1', '2', '3'), ('1', '3', '2'), ('2', '1', '3'), ('2', '3', '1'), ('3', '1', '2'), ('3', '2', '1')]
>>>
>>>print list(permutations(['1','2','3'],2))
[('1', '2'), ('1', '3'), ('2', '1'), ('2', '3'), ('3', '1'), ('3', '2')]
>>>
>>>print list(permutations('abc',3))
[('a', 'b', 'c'), ('a', 'c', 'b'), ('b', 'a', 'c'), ('b', 'c', 'a'), ('c', 'a', 'b'), ('c', 'b', 'a')]
```

### Task

You are given a string  $S$ .

Your task is to print all possible permutations of size  $k$  of the string in lexicographic sorted order.

### Input Format

A single line containing the space separated string  $S$  and the integer value  $k$ .

### Constraints

$$0 < k \leq \text{len}(S)$$

The string contains only UPPERCASE characters.

### Output Format

Print the permutations of the string  $S$  on separate lines.

### Sample Input

```
HACK2
```

### Sample Output

```
AC  
AH  
AK  
CA  
CH  
CK  
HA  
HC  
HK  
KA  
KC  
KH
```

### Explanation

All possible size 2 permutations of the string "HACK" are printed in lexicographic sorted order.

```
1 # Enter your code here. Read input from STDIN. Print output to STDOUT
2 from itertools import permutations
3 if __name__ == '__main__':
4     name,number = input(),int(input())
5     #print (list(itertools.permutations(name,number)))
6     s,n = input().split()
7     print(*[''.join(i) for i in permutations(sorted(s),int(n))],sep='\n')
8     # 这个表示这两个字母之间没有间隔
9     # 使用join默认数字和数字之间是有间隔的，这样就没有间隔了
10
```

```
1 # 错误解法
2 print(*['\n'.join(i) for i in permutations(sorted(s),int(n))])
3
4 # 输出的错误结果
5 ...
6 A
7 C A
8 H A
9 K C
10 A C
11 H C
12 K H
13 A H
14 C H
```

15 K K  
16 A K  
17 C K  
18 H  
19 ...

## 17. Python itertools.combinations

---

`itertools.combinations(iterable, r)`

### 排列组合，是组合不是排列

This tool returns the  $r$  length subsequences of elements from the input iterable.

Combinations are emitted in lexicographic sorted order. So, if the input iterable is sorted, the combination tuples will be produced in sorted order.

Sample Code

```
>>> from itertools import combinations
>>>
>>> print list(combinations('12345',2))
[('1', '2'), ('1', '3'), ('1', '4'), ('1', '5'), ('2', '3'), ('2', '4'), ('2', '5'), ('3', '4'), ('3', '5'), ('4', '5')]
>>>
>>> A=[1,1,3,3,3]
>>> print list(combinations(A,4))
[(1, 1, 3, 3), (1, 1, 3, 3), (1, 1, 3, 3), (1, 3, 3, 3), (1, 3, 3, 3)]
```

---

### Task

You are given a string  $S$ .

Your task is to print all possible combinations, up to size  $k$ , of the string in lexicographic sorted order.

#### Input Format

A single line containing the string  $S$  and integer value  $k$  separated by a space.

#### Constraints

$$0 < k \leq \text{len}(S)$$

The string contains only UPPERCASE characters.

#### Output Format

Print the different combinations of string  $S$  on separate lines.

#### Sample Input

```
HACK2
```

## Sample Output

```
A  
C  
H  
K  
AC  
AH  
AK  
CH  
CK  
HK
```

```
1 # Enter your code here. Read input from STDIN. Print output to STDOUT  
2 from itertools import combinations  
3 if __name__ == '__main__':  
4     s,k = input().split()  
5     #for i in range()  
6     for i in range(1, int(k)+1):  
7         for j in combinations(sorted(s), i):  
8             print (''.join(j),sep = '\n')  
9
```

## 18. Python itertools.groupby()

---

In this task, we would like for you to appreciate the usefulness of the groupby() function of itertools . To read more about this function, [Check this out](#) .

就是数每个数字出现了几次，然后用这种形式表达出来

You are given a string  $S$ . Suppose a character ' $c$ ' occurs consecutively  $X$  times in the string. Replace these consecutive occurrences of the character ' $c$ ' with  $(X, c)$  in the string.

For a better understanding of the problem, check the explanation.

**Input Format**

A single line of input consisting of the string  $S$ .

**Output Format**

A single line of output consisting of the modified string.

**Constraints**

All the characters of  $S$  denote integers between 0 and 9.

$1 \leq |S| \leq 10^4$

**Sample Input**

```
1222311
```

**Sample Output**

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

**Explanation**

First, the character 1 occurs only once. It is replaced by  $(1, 1)$  . Then the character 2 occurs three times, and it is replaced by  $(3, 2)$  and so on.

Also, note the single space within each compression and between the compressions.

**Python 中的分组函数 groupby( )**

groupby()

`groupby()` 把迭代器中相邻的重复元素挑出来放在一起: 

```
>>> for key, group in itertools.groupby('AAABBBCCAAA'):
...     print(key, list(group)) # 为什么这里要用list()函数呢?
...
A ['A', 'A', 'A']
B ['B', 'B', 'B']
C ['C', 'C']
A ['A', 'A', 'A']
```

实际上挑选规则是通过函数完成的，只要作用于函数的两个元素返回的值相等，这两个元素就被认为是在一组的，而函数返回值作为组的key。如果我们要忽略大小写分组，就可以让元素 '`A`' 和 '`a`' 都返回相同的key：

```
>>> for key, group in itertools.groupby('AaaBBbcCAAa', lambda c: c.upper()):
...     print(key, list(group))
...
A ['A', 'a', 'a']
B ['B', 'B', 'b']
C ['c', 'C']
A ['A', 'A', 'a']
```

`print(*objects, sep=' ', end='\n', file=sys.stdout, flush=False)`

`print` 函数默认是 `\n`，注意使用。这道题是每个结果的最后用空格分割。

```
1 # Enter your code here. Read input from STDIN. Print output to STDOUT
2 from itertools import groupby
3 if __name__ == '__main__':
4     #nums = list(input())
5     for i,j in groupby(input()):
6         print((len(list(j)),int(i)),end=" ")
7 ...
8 Sample Input
9 1222311
10 Sample Output
11 (1, 1) (3, 2) (1, 3) (2, 1)
12 ...
```

## 19. Python Iterables and Iterators

---

The `itertools` module standardizes a core set of fast, memory efficient tools that are useful by themselves or in combination. Together, they form an iterator algebra making it possible to construct specialized tools succinctly and efficiently in pure Python.

To read more about the functions in this module, check out their [documentation here](#).

You are given a list of  $N$  lowercase English letters. For a given integer  $K$ , you can select any  $K$  indices (assume 1-based indexing) with a uniform probability from the list.

Find the probability that at least one of the  $K$  indices selected will contain the letter: ' $a$ '.

### Input Format

The input consists of three lines. The first line contains the integer  $N$ , denoting the length of the list. The next line consists of  $N$  space-separated lowercase English letters, denoting the elements of the list.

The third and the last line of input contains the integer  $K$ , denoting the number of indices to be selected.

### Output Format

Output a single line consisting of the probability that at least one of the  $K$  indices selected contains the letter: ' $a$ '.

**Note:** The answer must be correct up to 3 decimal places.

### Constraints

$$1 \leq N \leq 10$$

$$1 \leq K \leq N$$

All the letters in the list are lowercase English letters.

### Sample Input

```
4
aacd
2
```

### Sample Output

```
0.8333
```

### Explanation:

All possible unordered tuples of length  $2$  comprising of indices from  $1$  to  $4$  are:

$$(1, 2), (1, 3), (1, 4), (2, 3), (2, 4), (3, 4)$$

Out of these  $6$  combinations,  $5$  of them contain either index  $1$  or index  $2$  which are the indices that contain the letter ' $a$ '.

Hence, the answer is  $\frac{5}{6}$ .

### 把 a a c d 用 1 2 3 4 指代去思考

```
1 # Enter your code here. Read input from STDIN. Print output to STDOUT
2 from itertools import combinations
3 if __name__ == '__main__':
```

```
4 m = int(input())
5 s = list(input().split())
6 n = int(input())
7 t = list(combinations(s,n))
8 f = [i for i in t if 'a' in i]
9 print(len(f)/len(t))
10 # len() is mainly used in 字符串或者数组
11
```

## Python 对len ()的使用

以下实例展示了 len() 的使用方法：

```
>>>str = "runoob"
>>> len(str)          # 字符串长度
6
>>> l = [1,2,3,4,5]
>>> len(l)            # 列表元素个数
5
```

## 20. Python Collections.Counter()

---

[collections.Counter\(\)](#)

**A counter is a container that stores elements as dictionary keys, and their counts are stored as dictionary values.**

这是Python中的字典类型的计数方式

Sample Code

```
>>> from collections import Counter  
>>>  
>>> myList=[1,1,2,3,4,5,3,2,3,4,2,1,2,3]  
>>> print Counter(myList)  
Counter({2: 4, 3: 4, 1: 3, 4: 2, 5: 1})  
>>>  
  
>>> print Counter(myList).items()  
[(1, 3), (2, 4), (3, 4), (4, 2), (5, 1)]  
>>>  
  
>>> print Counter(myList).keys()  
[1, 2, 3, 4, 5]  
>>>  
  
>>> print Counter(myList).values()  
[3, 4, 4, 2, 1]
```



Task

*Raghu* is a shoe shop owner. His shop has  $X$  number of shoes.

He has a list containing the size of each shoe he has in his shop.

There are  $N$  number of customers who are willing to pay  $x_i$  amount of money only if they get the shoe of their desired size.

Your task is to compute how much money *Raghu* earned.

Input Format

The first line contains  $X$ , the number of shoes.

The second line contains the space separated list of all the shoe sizes in the shop.

The third line contains  $N$ , the number of customers.

The next  $N$  lines contain the space separated values of the *shoe size* desired by the customer and  $x_i$ , the price of the shoe.

#### Constraints

$$0 < X < 10^3$$

$$0 < N \leq 10^3$$

$$20 < x_i < 100$$

$$2 < \text{shoe size} < 20$$

#### Output Format

Print the amount of money earned by *Raghu*.

#### Sample Input

```
10
23456876518
6
655
645
655
440
1860
1050
```

#### Sample Output

```
200
```

#### Explanation

Customer 1: Purchased size 6 shoe for \$55.

Customer 2: Purchased size 6 shoe for \$45.

Customer 3: Size 6 no longer available, so no purchase.

Customer 4: Purchased size 4 shoe for \$40.

Customer 5: Purchased size 18 shoe for \$60.

Customer 6: Size 10 not available, so no purchase.

Total money earned =  $55 + 45 + 40 + 60 = 200$

```
1 # Enter your code here. Read input from STDIN. Print output to STDOUT
2 import collections
3
4 numShoes = int(input())
5 shoes = collections.Counter(map(int, input().split()))
6 numCust = int(input())
7
8 income = 0
9
10 for i in range(numCust):
11     size, price = map(int, input().split())
12     if shoes[size]:
13         income += price
14         shoes[size] -= 1
15
16 print(income)
```

## 21. Python Collections.namedtuple()

### namedtuple

我们知道 `tuple` 可以表示不变集合，例如，一个点的二维坐标就可以表示成：

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

但是，看到 `(1, 2)`，很难看出这个 `tuple` 是用来表示一个坐标的。

定义一个 class 又小题大做了，这时，`namedtuple` 就派上了用场：

```
>>> from collections import namedtuple  
>>> Point = namedtuple('Point', ['x', 'y'])  
>>> p = Point(1, 2)  
>>> p.x  
1  
>>> p.y  
2
```

`namedtuple` 是一个函数，它用来创建一个自定义的 `tuple` 对象，并且规定了 `tuple` 元素的个数，并可以用属性而不是索引来引用 `tuple` 的某个元素。

这样一来，我们用 `namedtuple` 可以很方便地定义一种数据类型，它具备 `tuple` 的不变性，又可以根据属性来引用，使用十分方便。

可以验证创建的 `Point` 对象是 `tuple` 的一种子类：

```
>>> isinstance(p, Point)  
True  
>>> isinstance(p, tuple)  
True
```

类似的，如果要用坐标和半径表示一个圆，也可以用 `namedtuple` 定义：

```
# namedtuple('名称', [属性list]):  
Circle = namedtuple('Circle', ['x', 'y', 'r'])
```

### collections.namedtuple()

Basically, namedtuples are easy to create, lightweight object types.

They turn tuples into convenient containers for simple tasks.

With namedtuples, you don't have to use integer indices for accessing members of a tuple.

#### Example

##### Code 01

```
>>> from collections import namedtuple  
>>> Point = namedtuple('Point', 'x,y')  
>>> pt1 = Point(1,2)  
>>> pt2 = Point(3,4)  
>>> dot_product = (pt1.x * pt2.x) + (pt1.y * pt2.y)
```

```
>>> print dot_product  
11
```

Code 02

```
>>> from collections import namedtuple  
>>> Car = namedtuple('Car', 'Price Mileage Colour Class')  
>>> xyz = Car(Price = 100000, Mileage = 30, Colour = 'Cyan', Class = 'Y')  
>>> print xyz  
Car(Price=100000, Mileage=30, Colour='Cyan', Class='Y')  
>>> print xyz.Class  
Y
```

## Task

Dr. John Wesley has a spreadsheet containing a list of student's *IDs*, *marks*, *class* and *name*.

Your task is to help Dr. Wesley calculate the average marks of the students.

$$Average = \frac{\text{Sum of all marks}}{\text{Total Students}}$$

Note:

1. Columns can be in any order. IDs, marks, class and name can be written in any order in the spreadsheet.
2. Column names are ID, MARKS, CLASS and NAME. (The spelling and case type of these names won't change.)

## Input Format

The first line contains an integer *N*, the total number of students.

The second line contains the names of the columns in any order.

The next *N* lines contains the *marks*, *IDs*, *name* and *class*, under their respective column names.

## Constraints

$$0 < N \leq 100$$

## Output Format

Print the average marks of the list corrected to 2 decimal places.

## Sample Input

TESTCASE 01

```
5  
ID  MARKS  NAME  CLASS  
1  97    Raymond 7  
2  50    Steven 4  
3  91    Adrian 9  
4  72    Stewart 5  
5  80    Peter 6
```

TESTCASE 02

```
5  
MARKS  CLASS  NAME  ID
```

```
92      2      Calum  1
82      5      Scott   2
94      2      Jason   3
55      8      Glenn   4
82      2      Fergus  5
```

### Sample Output

TESTCASE 01

```
78.00
```

TESTCASE 02

```
81.00
```

### Explanation

TESTCASE 01

$$\text{Average} = (97 + 50 + 91 + 72 + 80)/5$$

Can you solve this challenge in 4 lines of code or less?

NOTE: There is no penalty for solutions that are correct but have more than 4 lines.

*classmethod somenamedtuple.\_make(iterable)*

Class method that makes a new instance from an existing sequence or iterable.

```
>>> t = [11, 22]
>>> Point._make(t)
Point(x=11, y=22)
```

```
1 # Enter your code here. Read input from STDIN. Print output to STDOUT
2 # Code Implementation
3 from collections import namedtuple
4 if __name__ == '__main__':
5     n, categories = int(input()), input().split()
6     Grade = namedtuple('Grade', categories)
7     marks = [int(Grade._make(input().split()).MARKS) for _ in range(n)]
8     #use _make to make the tuple
9     print((sum(marks) / len(marks)))
10
```

## 22. Python Collections.OrderedDict()

---

### [collections.OrderedDict](#)

An OrderedDict is a dictionary that remembers the order of the keys that were inserted first. If a new entry overwrites an existing entry, the original insertion position is left unchanged.

Python中的字典对象可以以“键：值”的方式存取数据。OrderedDict是它的一个子类，实现了对字典对象中元素的排序。比如下面比较了两种方式的不同：

#### Example

##### Code

```
>>>from collections import OrderedDict  
>>>  
>>>ordinary_dictionary={}  
>>>ordinary_dictionary['a']=1  
>>>ordinary_dictionary['b']=2  
>>>ordinary_dictionary['c']=3  
>>>ordinary_dictionary['d']=4  
>>>ordinary_dictionary['e']=5  
>>>  
>>>print ordinary_dictionary  
{'a': 1, 'c': 3, 'b': 2, 'e': 5, 'd': 4}  
>>>  
>>>ordered_dictionary=OrderedDict()  
>>>ordered_dictionary['a']=1  
>>>ordered_dictionary['b']=2  
>>>ordered_dictionary['c']=3  
>>>ordered_dictionary['d']=4  
>>>ordered_dictionary['e']=5  
>>>  
>>>print ordered_dictionary  
OrderedDict([('a', 1), ('b', 2), ('c', 3), ('d', 4), ('e', 5)])
```

---

#### Task

You are the manager of a supermarket.

You have a list of  $N$  items together with their prices that consumers bought on a particular day.

Your task is to print each item\_name and net\_price in order of its first occurrence.

`item_name` = Name of the item.

`net_price` = Quantity of the item sold multiplied by the price of each item.

## Input Format

The first line contains the number of items,  $N$ .

The next  $N$  lines contains the item's name and price, separated by a space.

## Constraints

$$0 < N \leq 100$$

## Output Format

Print the `item_name` and `net_price` in order of its first occurrence.

## Sample Input

```
9
BANANAFRIES 12
POTATO CHIPS 30
APPLE JUICE 10
CANDY 5
APPLE JUICE 10
CANDY 5
CANDY 5
CANDY 5
POTATO CHIPS 30
```

## Sample Output

```
BANANAFRIES 12
POTATO CHIPS 60
APPLE JUICE 20
CANDY 20
```

## Explanation

BANANA FRIES: Quantity bought: **1**, Price: **12**

Net Price: **12**

POTATO CHIPS: Quantity bought: **2**, Price: **30**

Net Price: **60**

APPLE JUICE: Quantity bought: **2**, Price: **10**

NetPrice: 20

CANDY: Quantity bought: 4, Price: 5

NetPrice: 20

```
1 # Enter your code here. Read input from STDIN. Print output to STDOUT
2 from collections import OrderedDict
3
4 number_ = int(input())
5 odict = OrderedDict()
6 for i in range(number_):
7     litem = input().split(' ')
8     price = int(litem[-1])
9     # when mentions the last element, use "-1"
10    item_name = " ".join(litem[:-1])
11    # before the last element, use " " to join the elements
12    if odict.get(item_name):
13        odict[item_name] += price
14    else:
15        odict[item_name] = price
16
17 for i,v in odict.items():
18     print(i,v)
19
20
```

## 23. Python Collections Word Order

---

Using `list` as the `default_factory`, it is easy to group a sequence of key-value pairs into a dictionary of lists:

```
>>> s = [('yellow', 1), ('blue', 2), ('yellow', 3), ('blue', 4), ('red', 1)]
>>> d = defaultdict(list)
>>> for k, v in s:
...     d[k].append(v)
...
>>> sorted(d.items())
[('blue', [2, 4]), ('red', [1]), ('yellow', [1, 3])]
```

---

You are given  $n$  words. Some words may repeat. For each word, output its number of occurrences. The output order should correspond with the input order of appearance of the word. See the sample input/output for clarification.

**Note:** Each input line ends with a "`\n`" character.

**Constraints:**

$$1 \leq n \leq 10^5$$

The sum of the lengths of all the words do not exceed  $10^6$

All the words are composed of lowercase English letters only.

**Input Format**

The first line contains the integer,  $n$ .

The next  $n$  lines each contain a word.

**Output Format**

Output 2 lines.

On the first line, output the number of distinct words from the input.

On the second line, output the number of occurrences for each distinct word according to their appearance in the input.

**Sample Input**

```
4
bcdef
abcdefg
bcde
bcdef
```

## Sample Output

```
3
2 1 1
```

## Explanation

There are **3** distinct words. Here, "**bcdef**" appears twice in the input at the first and last positions. The other words appear once each. The order of the first appearances are "**bcdef**", "**abcdefg**" and "**bcde**" which corresponds to the output.

解释：一共有3个不同的字符串；然后分别每个字符串出现的次数为2, 1, 1

```
1 # Enter your code here. Read input from STDIN. Print output to STDOUT
2 from collections import defaultdict
3 if __name__ == '__main__':
4     n = int(input())
5     #for i in range(n):
6     if 1<=n<=10**5:
7         d=defaultdict(int)
8         for i in range(n):
9             key=input()
10            d[key] +=1
11            print(len(d.keys()))
12 # the common usage 1)keys 2)values 3)items
13         x=(d.values())
14         print(*x)
```

## Recall:

```
>>>from collections import Counter
>>>
>>>myList=[1,1,2,3,4,5,3,2,3,4,2,1,2,3]
>>>print Counter(myList)
Counter({2: 4, 3: 4, 1: 3, 4: 2, 5: 1})
>>>

>>>print Counter(myList).items()
```

```
[(1, 3), (2, 4), (3, 4), (4, 2), (5, 1)]
```

```
>>>
```

```
>>> print Counter(myList).keys()
```

```
[1, 2, 3, 4, 5]
```

```
>>>
```

```
>>> print Counter(myList).values()
```

```
[3, 4, 4, 2, 1]
```

## 24. Python Collections.deque()

---

### **collections.deque()**

A deque is a double-ended queue. It can be used to add or remove elements from both ends.

Deques support thread safe, memory efficient appends and pops from either side of the deque with approximately the same  $O(1)$  performance in either direction.

Click on the link to learn more about **deque() methods**.

Click on the link to learn more about various approaches to working with deques: **Deque Recipes**.

#### **Example**

##### **Code**

```
>>> from collections import deque
>>> d = deque()
>>> d.append(1)
>>> print d
deque([1])
>>> d.appendleft(2)
>>> print d
deque([2, 1])
>>> d.clear()
>>> print d
deque([])
>>> d.extend('1')
>>> print d
deque(['1'])
>>> d.extendleft('234')
>>> print d
deque(['4', '3', '2', '1'])
>>> d.count('1')
1
>>> d.pop()
'1'
>>> print d
deque(['4', '3', '2'])
>>> d.popleft()
'4'
>>> print d
deque(['3', '2'])
>>> d.extend('7896')
```

```
>>> print d
deque(['3', '2', '7', '8', '9', '6'])
>>> d.remove('2')
>>> print d
deque(['3', '7', '8', '9', '6'])
>>> d.reverse()
>>> print d
deque(['6', '9', '8', '7', '3'])
>>> d.rotate(3)
>>> print d
deque(['8', '7', '3', '6', '9'])
```

## Task

Perform append, pop, popleft and appendleft methods on an empty deque  $d$ .

### Input Format

The first line contains an integer  $N$ , the number of operations.

The next  $N$  lines contains the space separated names of methods and their values.

### Constraints

$0 < N \leq 100$

### Output Format

Print the space separated elements of deque  $d$ .

### Sample Input

```
6
append 1
append 2
append 3
appendleft 4
pop
popleft
```

### Sample Output

```
12
```

```
1 # Enter your code here. Read input from STDIN. Print output to STDOUT
2 from collections import deque
3 if __name__ == '__main__':
```

```
4
5 d = deque()
6 for i in range(int(input())):
7     s = input().split()
8     if s[0] == 'append':
9         d.append(s[1])
10    elif s[0] == 'appendleft':
11        d.appendleft(s[1])
12    elif s[0] == 'pop':
13        d.pop()
14    else:
15        d.popleft()
16 print (" ".join(d) )
```

## 25. Python Collections Company Logo

---

A newly opened multinational brand has decided to base their company logo on the three most common characters in the company name. They are now trying out various combinations of company names and logos based on this condition. Given a string  $s$ , which is the company name in lowercase letters, your task is to find the top three most common characters in the string.

- Print the three most common characters along with their occurrence count.
- Sort in descending order of occurrence count.
- If the occurrence count is the same, sort the characters in alphabetical order.

For example, according to the conditions described above,

**GOOGLE** would have its logo with the letters **G, O, E**.

### Input Format

A single line of input containing the string  $S$ .

### Constraints

- $3 < \text{len}(S) \leq 10^4$

### Output Format

Print the three most common characters along with their occurrence count each on a separate line.

Sort output in descending order of occurrence count.

If the occurrence count is the same, sort the characters in alphabetical order.

### Sample Input 0

```
aabbccdde
```

### Sample Output 0

```
b 3
a 2
c 2
```

## Explanation 0

**aabbccde**

Here, b occurs **3** times. It is printed first.

Both a and c occur **2** times. So, a is printed in the second line and c in the third line because a comes before c in the alphabet.

**Note:** The string  $S$  has at least **3** distinct characters.

### most\_common([ $n$ ])

Return a list of the  $n$  most common elements and their counts from the most common to the least. If  $n$  is omitted or `None`, `most_common()` returns *all* elements in the counter. Elements with equal counts are ordered arbitrarily:

```
>>> Counter('abracadabra').most_common(3) # doctest: +SKIP
[(‘a’, 5), (‘r’, 2), (‘b’, 2)]
```

```
1 #!/bin/python3
2
3 import math
4 import os
5 import random
6 import re
7 import sys
8 from collections import Counter
9 from collections import OrderedDict
10 class OrderedCounter(Counter, OrderedDict):
11     pass
12 [print(*c) for c in OrderedCounter(sorted(input())).most_common(3)]
13 # see the most_common updates on the upfront
14
15 if __name__ == '__main__':
16     s = input()
```

## 26. Python Date and Time

---

### Calendar Module

The calendar module allows you to output calendars and provides additional useful functions for them.

**直接查API吧，内容比价琐碎，但是简单！**

```
class calendar.TextCalendar([firstweekday])
```

This class can be used to generate plain text calendars.

#### Sample Code

```
>>> import calendar  
>>>  
>>> print calendar.TextCalendar(firstweekday=6).formatyear(2015)  
2015
```

January	February	March
Su Mo Tu We Th Fr Sa	Su Mo Tu We Th Fr Sa	Su Mo Tu We Th Fr Sa
1 2 3	1 2 3 4 5 6 7	1 2 3 4 5 6 7
4 5 6 7 8 9 10	8 9 10 11 12 13 14	8 9 10 11 12 13 14
11 12 13 14 15 16 17	15 16 17 18 19 20 21	15 16 17 18 19 20 21
18 19 20 21 22 23 24	22 23 24 25 26 27 28	22 23 24 25 26 27 28
25 26 27 28 29 30 31		29 30 31

April	May	June
Su Mo Tu We Th Fr Sa	Su Mo Tu We Th Fr Sa	Su Mo Tu We Th Fr Sa
1 2 3 4	1 2	1 2 3 4 5 6
5 6 7 8 9 10 11	3 4 5 6 7 8 9	7 8 9 10 11 12 13
12 13 14 15 16 17 18	10 11 12 13 14 15 16	14 15 16 17 18 19 20
19 20 21 22 23 24 25	17 18 19 20 21 22 23	21 22 23 24 25 26 27
26 27 28 29 30	24 25 26 27 28 29 30	28 29 30
		31

July	August	September
Su Mo Tu We Th Fr Sa	Su Mo Tu We Th Fr Sa	Su Mo Tu We Th Fr Sa
1 2 3 4	1	1 2 3 4 5
5 6 7 8 9 10 11	2 3 4 5 6 7 8	6 7 8 9 10 11 12
12 13 14 15 16 17 18	9 10 11 12 13 14 15	13 14 15 16 17 18 19
19 20 21 22 23 24 25	16 17 18 19 20 21 22	20 21 22 23 24 25 26
26 27 28 29 30 31	23 24 25 26 27 28 29	27 28 29 30
		30 31

October	November	December
Su	Su	Su
Mo	Mo	Mo
1 2 3	1 2 3 4 5 6 7	1 2 3 4 5
4 5 6 7 8 9 10	8 9 10 11 12 13 14	6 7 8 9 10 11 12
11 12 13 14 15 16 17	15 16 17 18 19 20 21	13 14 15 16 17 18 19
18 19 20 21 22 23 24	22 23 24 25 26 27 28	20 21 22 23 24 25 26
25 26 27 28 29 30 31	29 30	27 28 29 30 31

To learn more about different calendar functions, [click here](#).

## Task

You are given a date. Your task is to find what the day is on that date.

### Input Format

A single line of input containing the space separated month, day and year, respectively, in  $MM\ DD\ YYYY$  format.

### Constraints

- $2000 < year < 3000$

### Output Format

Output the correct day in capital letters.

### Sample Input

```
08 05 2015
```

### Sample Output

```
WEDNESDAY
```

### Explanation

The day on August 5<sup>th</sup> 2015 was WEDNESDAY.

```

1 # Enter your code here. Read input from STDIN. Print output to STDOUT
2 import calendar
3 #calendar.Calendar(calendar.SUNDAY)
4 user_input = input().split()
5 # the input is divided into arrays...
6 month = int(user_input[0])

```

```
7 day = int(user_input[1])
8 year = int(user_input[2])
9 c = calendar.weekday(year, month, day)
10 # Directly use the python library, I don't even know why.
11 if c == 0:
12     print("MONDAY")
13 elif c == 1:
14     print("TUESDAY")
15 elif c == 2:
16     print("WEDNESDAY")
17 elif c==3:
18     print("THURSDAY")
19 elif c==4:
20     print("FRIDAY")
21 elif c== 5:
22     print("SATURDAY")
23 elif c==6:
24     print("SUNDAY")
```

## 27. Python Functionals Map and Lambda Function

---

Let's learn some new Python concepts! You have to generate a list of the first  $N$  fibonacci numbers,  $0$  being the first number. Then, apply the map function and a lambda expression to cube each fibonacci number and print the list.

### Concept

The map() function applies a function to every member of an iterable and returns the result. It takes two parameters: first, the function that is to be applied and secondly, the iterables.

Let's say you are given a list of names, and you have to print a list that contains the length of each name.

```
>> print(list(map(len,['Tina','Raj','Tom'])))  
[4, 3, 3]
```

Lambda is a single expression anonymous function often used as an inline function. In simple words, it is a function that has only one line in its body. It proves very handy in functional and GUI programming.

```
>> sum=lambda a,b,c:a+b+c  
>> sum(1,2,3)  
6
```

### Note:

Lambda functions cannot use the return statement and can only have a single expression. Unlike def, which creates a function and assigns it a name, lambda creates a function and returns the function itself. Lambda can be used inside lists and dictionaries.

### Input Format

One line of input: an integer  $N$ .

### Constraints

$0 \leq N \leq 15$

### Output Format

A list on a single line containing the cubes of the first  $N$  fibonacci numbers.

### Sample Input

## Sample Output

```
[0, 1, 1, 8, 27]
```

## Explanation

The first 5 fibonacci numbers are [0, 1, 1, 2, 3], and their cubes are [0, 1, 1, 8, 27].

```
1 cube = lambda x:x*x*x
2 # complete the lambda function
3
4
5 def fibonacci(n):
6     # return a list of fibonacci numbers
7     #fibonacci(1)=0
8     #fibonacci(2)=1
9     lis = [0,1]
10    #if n >=2:
11    #    lis[n]=lis[n-1]+lis[n-2]
12    for i in range(2,n):
13        lis.append(lis[i-1]+lis[i-2])
14    return lis[0:n]
15
16
17
18 if __name__ == '__main__':
19     n = int(input())
20     print(list(map(cube, fibonacci(n))))
```

## 28. Python Reduce Function (分数运算)

### 语法



reduce() 函数语法:

```
reduce(function, iterable[, initializer])
```

### 参数

function -- 函数, 有两个参数

iterable -- 可迭代对象

initializer -- 可选, 初始参数

### 返回值

返回函数计算结果。

### 实例

以下实例展示了 reduce() 的使用方法:

```
>>> def add(x, y) :           # 两数相加
...     return x + y
...
>>> reduce(add, [1,2,3,4,5])    # 计算列表和: 1+2+3+4+5
15
>>> reduce(lambda x, y: x+y, [1,2,3,4,5])  # 使用 lambda 匿名函数
15
```

Given a list of rational numbers, find their product.

#### Concept

The reduce() function applies a function of two arguments cumulatively on a list of objects in succession from left to right to reduce it to one value. Say you have a list, say [1,2,3] and you have to find its sum.

```
>>> reduce(lambda x, y : x + y,[1,2,3])
6
```

You can also define an initial value. If it is specified, the function will assume initial value as the value given, and then reduce. It is equivalent to adding the initial value at the beginning of the list. For example:

```
>>> reduce(lambda x, y : x + y, [1,2,3], -3)
3

>>> from fractions import gcd
>>> reduce(gcd, [2,4,8], 3)
1
```

## Input Format

First line contains  $n$ , the number of rational numbers.

The  $i^{\text{th}}$  of next  $n$  lines contain two integers each, the numerator( $N_i$ ) and denominator( $D_i$ ) of the  $i^{\text{th}}$  rational number in the list.

## Constraints

- $1 \leq n \leq 100$
- $1 \leq N_i, D_i \leq 10^9$

## Output Format

Print only one line containing the numerator and denominator of the product of the numbers in the list in its simplest form, i.e. numerator and denominator have no common divisor other than 1.

## Sample Input 0

```
3
1 2
3 4
10 6
```

## Sample Output 0

```
5 8
```

## Explanation 0

$$\frac{1}{2} \frac{3}{4} \frac{10}{6} = \frac{5}{8}$$

Required product is

```
1 from fractions import Fraction
2 from functools import reduce
3 import operator
4 def product(fracs):
5     #t = # complete this line with a reduce statement
6     #fracs1=[]
7     #for i in range(len(fracs)):
8     t = reduce(operator.mul , fracs) # complete this line with a reduce statement
9     return t.numerator, t.denominator
10
11 if __name__ == '__main__':
12     fracs = []
13     for _ in range(int(input())):
14         fracs.append(Fraction(*map(int, input().split())))
15     result = product(fracs)
16     print(*result)
```

## 29. Python Classes Dealing with Complex Numbers



---

For this challenge, you are given two complex numbers, and you have to print the result of their addition, subtraction, multiplication, division and modulus operations.

### 复数的加减乘除以及模运算

The real and imaginary precision part should be correct up to two decimal places.

#### Input Format

One line of input: The real and imaginary part of a number separated by a space.

#### Output Format

For two complex numbers  $C$  and  $D$ , the output should be in the following sequence on separate lines:

- $C + D$
- $C - D$
- $C * D$
- $C/D$
- $\text{mod}(C)$
- $\text{mod}(D)$

For complex numbers with non-zero real( $A$ ) and complex part( $B$ ), the output should be in the following format:

$A + Bi$

Replace the plus symbol (+) with a minus symbol (−) when  $B < 0$ .

For complex numbers with a zero complex part i.e. real numbers, the output should be:

$A + 0.00i$

For complex numbers where the real part is zero and the complex part( $B$ ) is non-zero, the output should be:

$0.00 + Bi$

#### Sample Input

## Sample Output

```
7.00+7.00i
-3.00-5.00i
4.00+17.00i
0.26-0.11i
2.24+0.00i
7.81+0.00i
```

## Concept

Python is a fully object-oriented language like C++, Java, etc. For reading about classes, refer [here](#).

Methods with a double underscore before and after their name are considered as built-in methods. They are used by interpreters and are generally used in the implementation of overloaded operators or other built-in functionality.

`__add__` -> Can be overloaded for + operation

`__sub__` -> Can be overloaded for - operation

`__mul__` -> Can be overloaded for \* operation

For more information on operator overloading in Python, refer [here](#).

```
1 import math
2
3 class Complex(object):
4     def __init__(self, real, imaginary):
5         self.real = real
6         self.imaginary = imaginary
7
8     def __add__(self, no):
9         real = self.real + no.real
```

```
10     imaginary = self.imaginary + no.imaginary
11     return Complex(real, imaginary)
12
13 def __sub__(self, no):
14     real = self.real - no.real
15     imaginary = self.imaginary - no.imaginary
16     return Complex(real, imaginary)
17
18 def __mul__(self, no):
19     real = self.real * no.real - self.imaginary * no.imaginary
20     imaginary = self.real * no.imaginary + self.imaginary * no.real
21     return Complex(real, imaginary)
22
23 def __div__(self, no):
24     x = float(no.real ** 2 + no.imaginary ** 2)
25     y = self * Complex(no.real, -no.imaginary)
26     real = y.real / x
27     imaginary = y.imaginary / x
28     return Complex(real, imaginary)
29
30 def mod(self):
31     real = math.sqrt(self.real ** 2 + self.imaginary ** 2)
32     return Complex(real, 0)
33
34 def __str__(self):
35     if self.imaginary == 0:
36         result = "%.2f+0.00i" % (self.real)
37     elif self.real == 0:
38         if self.imaginary >= 0:
39             result = "0.00+%.2fi" % (self.imaginary)
40         else:
41             result = "0.00-%.2fi" % (abs(self.imaginary))
42     elif self.imaginary > 0:
43         result = "%.2f+%.2fi" % (self.real, self.imaginary)
44     else:
45         result = "%.2f-%.2fi" % (self.real, abs(self.imaginary))
46     return result
47
48
49 C = map(float, raw_input().split())
50 D = map(float, raw_input().split())
51 x = Complex(*C)
52 y = Complex(*D)
53 print '\n'.join(map(str, [x+y, x-y, x*y, x/y, x.mod(), y.mod()]))
```

## 30. Python Classes Find the Torsional Angle

---

You are given four points  $A, B, C$  and  $D$  in a 3-dimensional Cartesian coordinate system. You are required to print the angle between the plane made by the points  $A, B, C$  and  $B, C, D$  in degrees(**not radians**). Let the angle be  $\text{PHI}$ .

$\text{Cos}(\text{PHI}) = (X \cdot Y) / |X||Y|$  where  $X = AB \times BC$  and  $Y = BC \times CD$ .

Here,  $X \cdot Y$  means the dot product of  $X$  and  $Y$ , and  $AB \times BC$  means the cross product of vectors  $AB$  and  $BC$ . Also,  $AB = B - A$ .

### Input Format

One line of input containing the space separated floating number values of the  $X, Y$  and  $Z$  coordinates of a point.

### Output Format

Output the angle correct up to two decimal places.

### Sample Input

```
045  
176  
059  
172
```

### Sample Output

```
8.19
```

```
1 # python2  
2 import math  
3 class Points(object):  
4     def __init__(self, x, y, z):  
5         self.x = x  
6         self.y = y  
7         self.z = z  
8  
9     def __sub__(self, no):  
10        x = self.x - no.x  
11        y = self.y - no.y  
12        z = self.z - no.z  
13        return Points(x, y, z)  
14  
15    def dot(self, no):
```

```
16     x = self.x * no.x
17     y = self.y * no.y
18     z = self.z * no.z
19     return x + y + z
20
21 def cross(self, no):
22     x = self.y * no.z - self.z * no.y
23     y = self.z * no.x - self.x * no.z
24     z = self.x * no.y - self.y * no.x
25     return Points(x, y, z)
26
27 def absolute(self):
28     return pow((self.x ** 2 + self.y ** 2 + self.z ** 2), 0.5)
29
30
31 points = list()
32 for i in range(4):
33     a = map(float, raw_input().split())
34     points.append(a)
35
36 A, B, C, D = Points(*points[0]), Points(*points[1]), Points(*points[2]), Points(*points[3])
37 X = (B - A).cross(C - B)
38 Y = (C - B).cross(D - C)
39 angle = math.acos(X.dot(Y) / (X.absolute() * Y.absolute()))
40
41 print "%.2f" % math.degrees(angle)
```

## 1. 二维数组中的查找

---

### 题目描述

在一个二维数组中（每个一维数组的长度相同），每一行都按照从左到右递增的顺序排序，每一列都按照从上到下递增的顺序排序。请完成一个函数，输入这样的一个二维数组和一个整数，判断数组中是否含有该整数。

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     # array 二 维 列 表
4     def Find(self, target, array):
5         if array == []:
6             return False
7         num_row = len(array) # get how many rows the array has
8         num_col = len(array[0])
9         i = num_col - 1
10        j = 0
11        while i >=0 and j<num_row:
12            if array[j][i]>target:
13                i = i - 1
14            elif array[j][i]<target:
15                j = j+1
16            else:
17                return True
18
```

## 2. 替换空格

---

请实现一个函数，将一个字符串中的每个空格替换成“%20”。例如，当字符串为We Are Happy.则经过替换之后的字符串为We%20Are%20Happy。

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     # s
4     def replaceSpace(self, s):
5         # write code here
6         i = 0
7         n = len(s)
8         ss=[]#用 于 盛 放 转 化 完 的 字 符 串
9         for i in range(n):
10             if s[i].isspace():#判 断 是 否 为 空 格
11                 ss.append('%20')
12             else:
13                 ss.append(s[i])
14             i +=1
15         ss=''.join(ss)#将 列 表 转 成 字 符 串
16         return ss
17
18
```



### 3. 从尾到头打印链表

---

#### 题目描述

输入一个链表，按链表值从尾到头的顺序返回一个ArrayList。

```
1 # -*- coding:utf-8 -*-
2 class ListNode:
3     def __init__(self, x):
4         self.val = x
5         self.next = None
6 class Solution:
7     # 返回从尾部到头部的列表值序列，例如 [1,2,3]
8     def printListFromTailToHead(self, listNode):
9         # write code here
10        # 注意，Python 中没有那个 == NULL 的写法
11        if listNode == []:
12            return False
13        result = []
14
15        while listNode:
16            result.insert(0, listNode.val) # 这种写法就相当于把 Python 最开始的元
素向后顶了
17            listNode = listNode.next
18        return result
19
```

## 4. 重建二叉树

### 题目描述

输入某二叉树的前序遍历和中序遍历的结果，请重建出该二叉树。假设输入的前序遍历和中序遍历的结果中都不含重复的数字。例如输入前序遍历序列{1,2,4,7,3,5,6,8}和中序遍历序列{4,7,2,1,5,3,8,6}，则重建二叉树并返回。

```
1 # -*- coding:utf-8 -*-
2 class TreeNode:
3     #Need to understand again!
4     def __init__(self, x):
5         self.val = x
6         self.left = None
7         self.right = None
8 class Solution:
9     # 返回构造的TreeNode根节点
10    def reConstructBinaryTree(self, pre, tin):
11        # write code here
12        if not pre and not tin:
13            return None
14        root = TreeNode(pre[0])
15        if set(pre) != set(tin):
16            return None
17        i = tin.index(pre[0])
18        root.left = self.reConstructBinaryTree(pre[1:i+1], tin[:i])
19        root.right = self.reConstructBinaryTree(pre[i+1:], tin[i+1:])
20        return root
```

A: 利用二叉树前序遍历和中序遍历的特点，前序遍历的第一个值一定为根节点，对应于中序遍历中间的一个点，在中序遍历中，该点左侧的值为根节点的左子树，右侧的值为根节点的右子树。这时可以利用递归，取前序遍历的[1:i+1]和中序遍历的[:i]作为对应的左子树继续上一个过程，取前序遍历的[i+1:]和中序遍历的[i+1:]对应与右子树继续上一个过程，重建二叉树。

```
class Solution:
    def reConstructBinaryTree(self, pre, tin):
        if not pre or not tin:
            return None
        root = TreeNode(pre.pop(0))
        index = tin.index(root.val)
        root.left = self.reConstructBinaryTree(pre, tin[:index])
        root.right = self.reConstructBinaryTree(pre, tin[index + 1:])
        return root
```

## 5. 用两个栈实现队列

---

### 题目描述

用两个栈来实现一个队列，完成队列的Push和Pop操作。队列中的元素为int类型。

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     def __init__(self):
4         self.stack1=[]
5         self.stack2=[]
6
7     def push(self, node):
8         # write code here
9         self.stack1.append(node)
10
11    def pop(self):
12        # return xx
13        if len(self.stack1) == 0 and len(self.stack2) == 0:
14            return
15        elif len(self.stack2) == 0:
16            while len(self.stack1) > 0:
17                self.stack2.append(self.stack1.pop())
18        return self.stack2.pop()
```



## 6. 旋转数组的最小数字

### 题目描述

把一个数组最开始的若干个元素搬到数组的末尾，我们称之为数组的旋转。输入一个非减排序的数组的一个旋转，输出旋转数组的最小元素。例如数组{3,4,5,1,2}为{1,2,3,4,5}的一个旋转，该数组的最小值为1。

NOTE：给出的所有元素都大于0，若数组大小为0，请返回0。

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     def minNumberInRotateArray(self, rotateArray):
4         # write code here
5         # 重新理解下，这道题目非常重要！！！
6         if len(rotateArray) == 0:
7             return 0
8         front = 0
9         rear = len(rotateArray)-1
10        minValue = rotateArray[0]
11        if rotateArray[front] < rotateArray[rear]:
12            return rotateArray[front]
13        else:
14            # 要查找最小值，用二分查找的方法还是最方便的
15            while (rear-front)> 1:
16                mid = (front+rear)//2
17                if rotateArray[mid]>=rotateArray[front]:
18                    front = mid
19                elif rotateArray[mid]<=rotateArray[rear]:
20                    rear = mid
21                elif rotateArray[front] == rotateArray[rear] == rotateArray[mid]:
22                    for i in range(1,len(rotateArray)):
23                        if rotateArray[i]<minValue:
24                            minValue = rotateArray[i]
25                            rear = i
26        minValue = rotateArray[rear]
27        return minValue
28
```

### # 方法三

```
class Solution:
    def minNumberInRotateArray(self, rotateArray):
        # write code here
        if not rotateArray:
            return 0
        else:
            rotateArray.sort()
            return rotateArray[0]
```

### # 方法二：

```
class Solution:
    def minNumberInRotateArray(self, rotateArray):
        # write code here
        if not rotateArray:
            return 0
        else:
            return min(rotateArray)
```

## 7. 斐波那契数列（动态规划）

---

### 题目描述

大家都知道斐波那契数列，现在要求输入一个整数n，请你输出斐波那契数列的第n项（从0开始，第0项为0）。

n<=39

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     def Fibonacci(self, n):
4         # write code here
5         # 这种解法是非递归的解法
6         tempArray = [0,1]
7         #tempArray[0]=0
8         #tempArray[1]=1
9
10        if n<=1:
11            return tempArray[n]
12        if n>=2 and n<=39:
13            for i in range(2,n+1):
14                # 不能用这种方法去赋值，并没有定义空间是多少，c++也类似，碰到
15                # 这种情况只能push_back
16                #tempArray[i]=tempArray[i-1]+tempArray[i-2]
17                tempArray.append(tempArray[i-1]+tempArray[i-2])
18        return tempArray[n]
19
```

```
1 # 递归实现算法复杂度太高了递归实现算法复杂度太高了了，是指级别的
2 # 递归实现算法
3 class Solution():
4     def Fibnacci(self,n):
5         if n <= 0:
6             return 0
7         if n == 1:
8             return 1
9         return self.Fibnacci(n-1) + self.Fibnacci(n-2)
```

## 8. 跳台阶 (动态规划)

---

### 题目描述

一只青蛙一次可以跳上1级台阶，也可以跳上2级。求该青蛙跳上一个n级的台阶总共有多少种跳法（先后次序不同算不同的结果）。

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     def jumpFloor(self, number):
4         # write code here
5         # 可以理解为分情况的斐波拉契递归的程序
6         # 可以理解为n=1 1种方法； n=2时， 2中方法； 然后递归计算
7         rempArray=[1,2]
8         if number<=2:
9             return number
10        elif number >= 3:
11            for i in range(2,number):
12                rempArray.append(rempArray[i-1]+rempArray[i-2])
13        return rempArray[number-1]
14
```

## 9. 变态跳台阶 (动态规划)

---

### 题目描述

一只青蛙一次可以跳上1级台阶，也可以跳上2级……它也可以跳上n级。求该青蛙跳上一个n级的台阶总共有多少种跳法。

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     def jumpFloorII(self, number):
4         # write code here
5         # for 1, 1 solution; for 2, 2 solution; for 3, 4 solutions
6         # 为什 么 是 两 倍 , 想 不 通 ? ? ?
7         rempArray = [1,2]
8         if number <=2:
9             return number
10        elif number >= 3:
11            for i in range(2,number):
12                #rempArray[i]=rempArray[i-1]+rempArray[i-2]+1
13                rempArray.append(rempArray[i-1]*2)
14        return rempArray[number-1]
```

因为n级台阶，第一步有n种跳法：跳1级、跳2级、到跳n级  
跳1级，剩下n-1级，则剩下跳法是f(n-1)  
跳2级，剩下n-2级，则剩下跳法是f(n-2)  
所以 $f(n)=f(n-1)+f(n-2)+\dots+f(1)$   
因为 $f(n-1)=f(n-2)+f(n-3)+\dots+f(1)$   
所以 $f(n)=2*f(n-1)$

## 10. 矩形覆盖 (动态规划)

---

### 题目描述

我们可以用 $2 \times 1$ 的小矩形横着或者竖着去覆盖更大的矩形。请问用 $n$ 个 $2 \times 1$ 的小矩形无重叠地覆盖一个 $2 \times n$ 的大矩形，总共有多少种方法？

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     def rectCover(self, number):
4         # write code here
5         # n= 1, 1 种 ; n=2, 2 种 ;
6         rempArray=[1,2]
7         if number <=2:
8             return number
9         elif number >=3:
10            for i in range(2,number):
11                rempArray.append(rempArray[i-1]+rempArray[i-2])
12            return rempArray[number-1]
13        ...
14        rempArray=[1,2]
15        if number<=2:
16            return number
17        elif number >= 3:
18            for i in range(2,number):
19                rempArray.append(rempArray[i-1]+rempArray[i-2])
20            return rempArray[number-1]
21        ...
```

## 11. 二进制中1的个数（位运算）

---

### 题目描述

输入一个整数，输出该数二进制表示中1的个数。其中负数用补码表示。

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     def Number0f1(self, n):
4         # 看一下剑指offer书里怎么写的！！！
5         # 每个非零整数n和n-1进行按位与运算，整数n的二进制中，
6         # 最右边的1就会变成0，利用循环，计算经过几次运算二进制变成0
7         # 就有几个1。
8         # 需要重新看一次！！！
9         count = 0
10        if n < 0:
11            n = n & 0xffffffff
12        while n != 0:
13            count += 1
14            n = (n - 1) & n
15        return count
```

## 12. 数值的整数次方（位运算）

---

### 题目描述

给定一个double类型的浮点数base和int类型的整数exponent。求base的exponent次方。

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     def Power(self, base, exponent):
4         # write code here
5         return pow(base,exponent)
6     # 这个会不会太简单了，看看别人怎么写的！！
7
8
9
10
11
12
13
14
15
16
17 上面的很简单，没有使用快速幂算法，下面使用一下快速幂算法，快速
18 幂算法参考下面的博客
19 https://blog.csdn.net/hkdgjqr/article/details/5381028
20
21     def fast_power(self, base, exponent):
22         if base == 0:
23             return 0
24         if exponent == 0:
25             return 1
26         e = abs(exponent)
27         tmp = base
28         res = 1
29         while(e > 0):
30             #如果最后一位为1，那么给res乘上这一位的结果
31             if (e & 1 == 1):
32                 res = res * tmp
33             e = e >> 1
34             tmp = tmp * tmp
35         return res if exponent > 0 else 1/res
```

## 13. 调整数组顺序使奇数位于偶数前面

---

### 题目描述

输入一个整数数组，实现一个函数来调整该数组中数字的顺序，使得所有的奇数位于数组的前半部分，所有的偶数位于数组的后半部分，并保证奇数和奇数，偶数和偶数之间的相对位置不变。

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     def re0rderArray(self, array):
4         # write code here
5         #myarray = list(array)
6         result = []
7         for i in range(len(array)):
8             if array[i]%2 ==1:
9                 result.append(array[i])
10            for j in range(len(array)):
11                if array[j]%2 == 0:
12                    result.append(array[j])
13        return result
14
```

## 14. 链表汇总倒数第k个节点（链表）



### 题目描述

输入一个链表，输出该链表中倒数第k个结点。

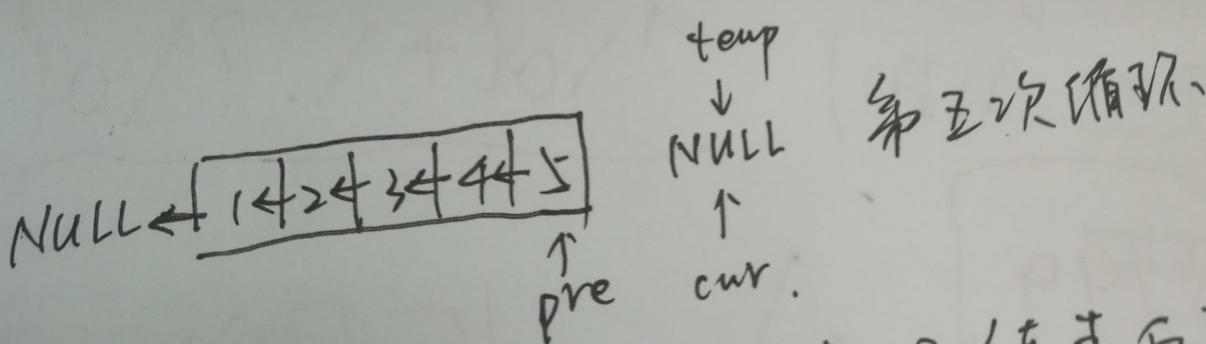
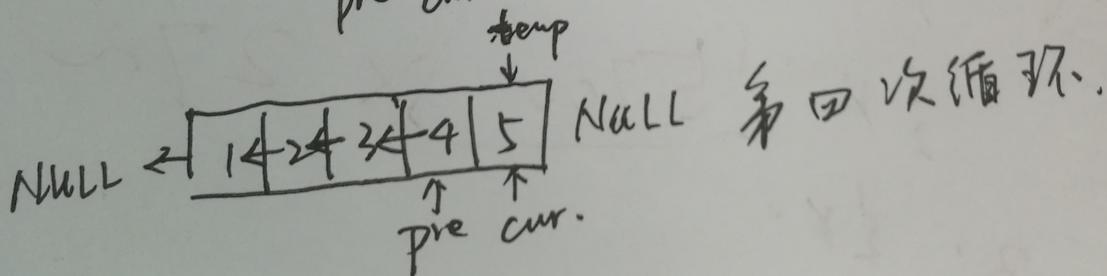
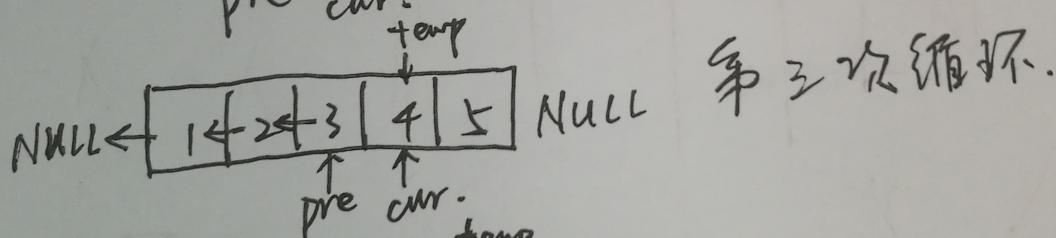
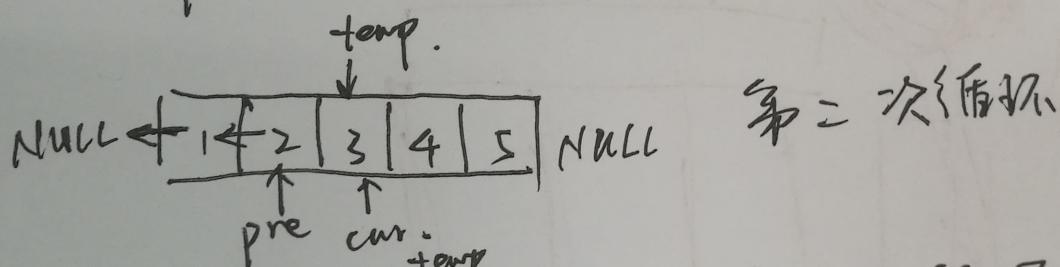
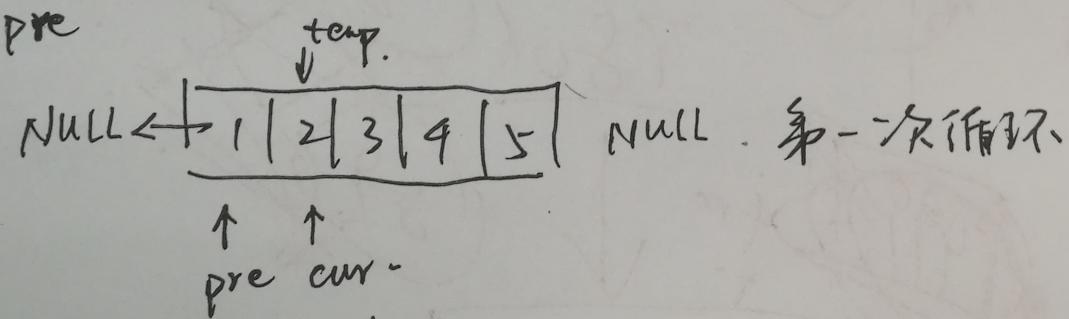
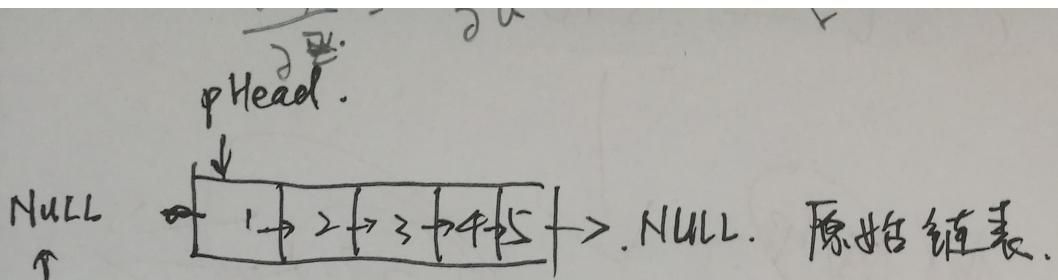
```
1 # -*- coding:utf-8 -*-
2 class ListNode:
3     def __init__(self, x):
4         self.val = x
5         self.next = None
6 # Need to repeat again!!! 这种思路可以学习！！！
7 # 设置两个指针指向头节点，第一个指针向前走 k-1 步，走到第 k 个结点，此时，
8 # 第二个指针和第一个指针同时移动，当第一个指针到尾节点的时候，
9 # 第二个指针指向倒数第 k 个结点，注意链表为空，k 为 0，k 大于链表的长度的情况
10 class Solution:
11     def FindKthToTail(self, head, k):
12         # write code here
13         # 链表的倒数第 k 个节点
14         # 设计到倒数第 k 个的问题，总是可以这样两个夹一下！！！
15         if head == None or k <= 0:
16             return None
17
18         pAhead = head # 表示指向头指针
19         pBhead = None # 表示没有指向任何指针
20
21         for i in range(k-1):
22             if pAhead.next != None:
23                 pAhead = pAhead.next
24             else:
25                 return None
26         pBhead = head
27         while pAhead.next != None:
28             pAhead = pAhead.next
29             pBhead = pBhead.next
30
31         return pBhead
```

## 15. 反转链表（链表）

---

### 题目描述

输入一个链表，反转链表后，输出新链表的表头。



故，输出 pre 即可实现链表反转.

```

1 # -*- coding:utf-8 -*-
2 class ListNode:
3     def __init__(self, x):

```

```
4     self.val = x
5     self.next = None
6 class Solution:
7     # 返回 ListNode
8     # 这道题目很基础，我还是没写起来，看一下桌面上那个画的示意图
9     !
10    !
11    def ReverseList(self, pHead):
12        # write code here
13        if pHead==None or pHead.next==None:
14            return pHead
15        # pre 和 cur 是两个标记指针，一前一后
16        pre = None # 前面的指针
17        cur = pHead # 后面的指针
18        while cur!=None:
19            tmp = cur.next# 标志 cur 后面的指针
20            cur.next = pre # 标志 cur 前面的指针
21            pre = cur # 指针向后移动
22            cur = tmp # 指针向后移动
23        return pre
```

这一步相当于移动指针，用于下次迭代

## 16. 合并两个排序的链表 (链表)

### 题目描述

输入两个单调递增的链表，输出两个链表合成后的链表，当然我们需要合成后的链表满足单调不减规则。

```
1 # -*- coding:utf-8 -*-
2 class ListNode:
3     def __init__(self, x):
4         self.val = x
5         self.next = None
6 class Solution:
7     # 返回合并后列表
8     # 重新理解一下这种调用自身的方法！！！---就是递归
9
10    ...
11    1 对2个链表是否为空进行处理
12    2 比较2个链表头结点的值得大小，把较小的一个作为新链表的头结点，继续判断剩余2个链表的头结点
13    的大小，返回结点，与上一个连接起来，然后递归的进行运算。递归判断条件就是其中一个链表为空，返回剩余的链表，与之前的连接起来。
14    ...
15    #这种是非递归的方式
16    def Merge(self, pHead1, pHead2):
17        #write code here
18        phead = ListNode(0)# 创建链表
19        tmp = phead # 新建链表指针
20        while pHead1 and pHead2:
21            if pHead1.val <= pHead2.val:
22                tmp.next = pHead1
23                pHead1 = pHead1.next
24            else:
25                tmp.next = pHead2
26                pHead2 = pHead2.next
27            tmp = tmp.next # 更改tmp游标的位罝，表示现在这才是tmp
28
29            if pHead1 is None:
30                tmp.next = pHead2# 直接把pHead2接到这个指针后面
31            if pHead2 is None:
32                tmp.next = pHead1
33
34            #return tmp
35        return phead.next # 如果不加next，就会出现初始定义的那个0
36
37
```

```
1
2 #这个是递归的版本
3 def Merge(self, pHead1, pHead2):
4     # write code here
5     if pHead1==None:
6         return pHead2
7     if pHead2 == None:
8         return pHead1
9     pMergeHead = None
```

```
10 if pHead1.val<=pHead2.val:
11     pMergeHead = pHead1
12     #pHead1=pHead1.next
13     pMergeHead.next = self.Merge(pHead1.next,pHead2)
14 elif pHead1.val>pHead2.val:
15     pMergeHead = pHead2
16     #pHead2=pHead2.next
17     pMergeHead.next = self.Merge(pHead2.next, pHead1)
18 return pMergeHead
19
20
```

## 17. 树的子结构（树）

---

### 题目描述

输入两棵二叉树A, B, 判断B是不是A的子结构。 (ps: 我们约定空树不是任意一个树的子结构)

```
1 # -*- coding:utf-8 -*-
2 class TreeNode:
3     def __init__(self, x):
4         self.val = x
5         self.left = None
6         self.right = None
7 class Solution:
8     # 树的题目，很多都用到递归
9     # 回头重点看的一道题目
10    ...
11    思路：对A树DFS，如果B的根节点与A中某个节点值相同，那么以B为树
12    根进行DFS，判断即可
13    时间复杂度为O(n * m)
14    ...
15    def HasSubtree(self, pRoot1, pRoot2):
16        # write code here
17        result = False
18        if pRoot1 != None and pRoot2 != None:
19            if pRoot1.val == pRoot2.val:
20                result = self.DoesTree1haveTree2(pRoot1, pRoot2)
21            if not result:
22                result = self.HasSubtree(pRoot1.left, pRoot2)
23            if not result:
24                result = self.HasSubtree(pRoot1.right, pRoot2)
25        return result
26    # 用于递归判断树的每个节点是否相同
27    # 需要注意的地方是：前两个if语句不可以颠倒顺序
28    # 如果颠倒顺序，会先判断pRoot1是否为None，其实这个时候pRoot2的结点
29    # 已经遍历完成确定相等了，但是返回了False，判断错误
30    def DoesTree1haveTree2(self, pRoot1, pRoot2):
31        if pRoot2 == None:
32            return True
33        if pRoot1 == None:
34            return False
35        if pRoot1.val != pRoot2.val:
36            return False
37        return self.DoesTree1haveTree2(pRoot1.left, pRoot2.left) and self.DoesTree1haveT
ree2(pRoot1.right, pRoot2.right)
```

## 18. 二叉树的镜像（树）

### 题目描述

操作给定的二叉树，将其变换为源二叉树的镜像。

输入描述:

二叉树的镜像定义：源二叉树

```
    8
   /   \
  6   10
 / \   / \
5  7  9  11
```

镜像二叉树

```
    8
   /   \
  10   6
 / \   / \
11  9  7  5
```

```
1 # -*- coding:utf-8 -*-
2 class TreeNode:
3     def __init__(self, x):
4         self.val = x
5         self.left = None
6         self.right = None
7 class Solution:
8     # 返回镜像树的根节点
9     # 没有太看懂，重新看一遍！！！
10    # 回头重点看！
11    def Mirror(self, root):
12        # write code here
13        if root == None:
14            return
15        if root.left == None and root.right == None:
16            return root
17        temp = root.left
18        root.left = root.right
19        root.right = temp
20        # 递归调用自己的函数
21        self.Mirror(root.left)
22        self.Mirror(root.right)
```

## 19. 顺时针打印矩阵

---

### 题目描述

输入一个矩阵，按照从外向里以顺时针的顺序依次打印出每一个数字，例如，如果输入如下 $4 \times 4$ 矩阵： 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 则依次打印出数字1,2,3,4,8,12,16,15,14,13,9,5,6,7,11,10.

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     # matrix类型为二维列表，需要返回列表
4     # 重新看一遍，理解一遍！！！
5     """
6     直接顺时针去数数字就可以了
7     """
8     def printMatrix(self, matrix):
9         res = []
10        while matrix:
11            res += matrix.pop(0)
12            # pop默认是堆栈方式，pop(0)就是队列方式
13            if matrix and matrix[0]:
14                for row in matrix:
15                    res.append(row.pop(0))
16            if matrix:
17                res += matrix.pop()[:-1]
18                if matrix and matrix[0]:
19                    for row in matrix[:-1]:
20                        res.append(row.pop(0))
21        return res
22
```

## 20. 包含min函数的栈（堆栈）

---

### 题目描述

定义栈的数据结构，请在该类型中实现一个能够得到栈中所含最小元素的min函数（时间复杂度应为 $O(1)$ ）。

```
1 # -*- coding:utf-8 -*-
2 ...
3 用例：
4 ["PSH3","MIN","PSH4","MIN","PSH2","MIN","PSH3","MIN","POP","MIN","POP","MIN","POP","MIN"
5 , "PSH0","MIN"]
6 对应输出应该为：
7
8 3,3,2,2,2,3,3,0
9
10 ...
11 # 这道题目意思不清楚，看一下原来的书上怎么写的
12 class Solution:
13     def __init__(self):
14         self.stack = []
15         self.minStack = [] # 保存最小元素的堆栈
16         # 重新思考，理解一下！！！
17         # 建立一个辅助栈，每次都把最小值压入辅助栈，这样辅助栈的栈顶一直是最小元素。
18         # 当数据栈中，最小值被弹出时，同时弹出辅助栈的栈顶元素。
19     def push(self, node):
20         # write code here
21         # self表示创建的类实例本身
22         # 加了self可以实现跨方法调用
23         # 调用self的时候不必为这个参数赋值
24         self.stack.append(node)
25         if self.minStack == [] or node < self.min():
26             self.minStack.append(node)
27         else:
28             temp = self.min()
29             self.minStack.append(temp)
30
31     def pop(self):
32         # write code here
33         # self.stack.pop(node)
34         if self.stack == None or self.minStack == None:
35             return None
36         self.minStack.pop()
37         self.stack.pop()
38     def top(self):
39         # write code here
40         return self.stack[-1]
41     def min(self):
42         # write code here
43         return self.minStack[-1]
```

## 21. 栈的压入、弹出序列 (堆栈)

---

### 题目描述

输入两个整数序列，第一个序列表示栈的压入顺序，请判断第二个序列是否可能为该栈的弹出顺序。假设压入栈的所有数字均不相等。例如序列1,2,3,4,5是某栈的压入顺序，序列4,5,3,2,1是该压栈序列对应的一个弹出序列，但4,3,5,1,2就不可能是该压栈序列的弹出序列。（注意：这两个序列的长度是相等的）

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     def IsPopOrder(self, pushV, popV):
4         # write code here
5         # 重新总结与思考！！！
6         # 这种解题的思想特别好
7         if pushV == [] or popV == []:
8             return None
9         # python 中用堆栈都是用 []
10        stack = []
11        for i in pushV:
12            stack.append(i)
13            while len(stack) and stack[-1]==popV[0]:
14                stack.pop()#pop默认是最最后一个
15                popV.pop(0)
16        if len(stack):
17            return False
18        else:
19            return True
```

## 22. 从上往下打印二叉树（树）

---

### 题目描述

从上往下打印出二叉树的每个节点，同层节点从左至右打印。

```
1 # -*- coding:utf-8 -*-
2 class TreeNode:
3     def __init__(self, x):
4         self.val = x
5         self.left = None
6         self.right = None
7 class Solution:
8     # 返回从上到下每个节点值列表，例：[1,2,3]
9     # 重新思考！！！非常精彩！
10    def PrintFromTopToBottom(self, root):
11        # write code here
12        #if root.left == None and root.right == None:
13        #    return root
14        # 这个为什么不行！！
15        if root == None:
16            return []
17        queue = []
18        result = []
19        queue.append(root) # list可以用在树结构里
20        while len(queue) > 0:
21            currentRoot = queue.pop(0)
22            result.append(currentRoot.val)
23            if currentRoot.left:
24                queue.append(currentRoot.left)
25            if currentRoot.right:
26                queue.append(currentRoot.right)
27
28        return result
29
30
31
```

## 23. 二叉搜索树的后序遍历序列（树）

---

### 题目描述

输入一个整数数组，判断该数组是不是某二叉搜索树的后序遍历的结果。如果是则输出Yes,否则输出No。假设输入的数组的任意两个数字都互不相同。

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     def VerifySquenceOfBST(self, sequence):
4         # write code here
5         if len(sequence) == 0:
6             return False
7
8         root = sequence[-1]
9
10        # 在二叉搜索中左子树的结点小于跟结点
11        i = 0
12        for node in sequence[:-1]:
13            if node > root:
14                break
15            i += 1
16
17        # 在二叉搜索中右子树的结点小于跟结点
18        for node in sequence[i:-1]:
19            if node < root:
20                return False
21
22        # 判断左子树是不是二叉搜索树
23        left = True
24        if i > 1:
25            left = self.VerifySquenceOfBST(sequence[:i])
26        right = True
27        if i < len(sequence) - 2 and left:
28            right = self.VerifySquenceOfBST(sequence[i+1:-1])
29        return left and right
30
31
32
```

## 24. 二叉树中和为某一值的序列（树）

---

### 题目描述

输入一颗二叉树的跟节点和一个整数，打印出二叉树中结点值的和为输入整数的所有路径。路径定义为从树的根结点开始往下一直到叶结点所经过的结点形成一条路径。(注意: 在返回值的list中，数组长度大的数组靠前)

```
1 # -*- coding:utf-8 -*-
2 class TreeNode:
3     def __init__(self, x):
4         self.val = x
5         self.left = None
6         self.right = None
7 class Solution:
8     # 返回二维列表，内部每个列表表示找到的路径
9     # 没看懂，回头研究！！
10    def FindPath(self, root, expectNumber):
11        def subFindPath(root):
12            if root:
13                b.append(root.val)
14                if not root.right and not root.left and sum(b) == expectNumber:
15                    a.append(b[:])
16                else:
17                    subFindPath(root.left), subFindPath(root.right)
18                b.pop()
19        a, b = [], []
20        subFindPath(root)
21        return a
22
23
```

## 25. 复杂链表的复制（链表）

### 题目描述

输入一个复杂链表（每个节点中有节点值，以及两个指针，一个指向下一个节点，另一个特殊指针指向任意一个节点），返回结果为复制后复杂链表的head。（注意，输出结果中请不要返回参数中的节点引用，否则判题程序会直接返回空）

具体分为三步：

(1) 在旧链表中创建新链表，此时不处理新链表的兄弟结点

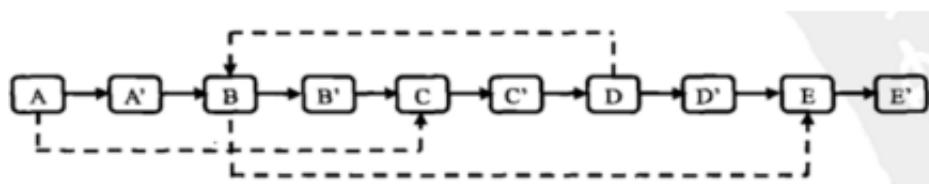


图 4.9 复制复杂链表的第一步

<http://blog.csdn.net/insistGoGo>

(2) 根据旧链表的兄弟结点，初始化新链表的兄弟结点

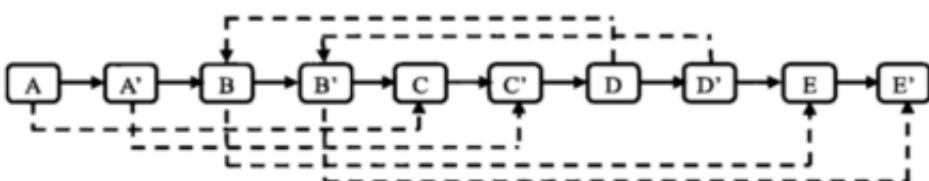


图 4.10 复制复杂链表的第二步

<http://blog.csdn.net/insistGoGo>

(3) 从旧链表中拆分得到新链表

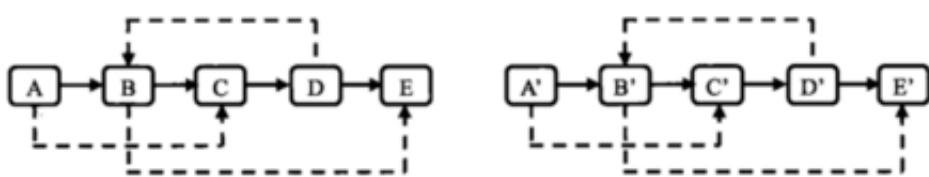


图 4.11 复制复杂链表的第三步

<http://blog.csdn.net/insistGoGo>

```
1 # -*- coding:utf-8 -*-
2 class RandomListNode:
3     def __init__(self, x):
4         self.label = x
5         self.next = None
6         self.random = None
7 class Solution:
8     # 返回 RandomListNode
9     # 重新回头看题目！
10    def Clone(self, pHead):
11        if not pHead:
```

```
12     return None
13
14
15 # first step, N' to N next
16 while dummy:
17     dummysnext = dummy.next
18     copynode = RandomListNode(dummy.label)
19     copynode.next = dummysnext
20     dummy.next = copynode
21     dummy = dummysnext
22
23     dummy = pHead
24
25 # second step, random' to random'
26 while dummy:
27     dummyrandom = dummy.random
28     copynode = dummy.next
29     if dummyrandom:
30         copynode.random = dummyrandom.next
31     dummy = copynode.next
32
33 # third step, split linked list
34 dummy = pHead
35 copyHead = pHead.next
36 while dummy:
37     copyNode = dummy.next
38     dummysnext = copyNode.next
39     dummy.next = dummysnext
40     if dummysnext:
41         copyNode.next = dummysnext.next
42     else:
43         copyNode.next = None
44     dummy = dummysnext
45
46
47 return copyHead
```

## 26. 二叉搜索树与双向链表（树、链表）

### 题目描述

输入一棵二叉搜索树，将该二叉搜索树转换成一个排序的双向链表。要求不能创建任何新的结点，只能调整树中结点指针的指向。

```
1 # -*- coding:utf-8 -*-
2 class TreeNode:
3     def __init__(self, x):
4         self.val = x
5         self.left = None
6         self.right = None
7 class Solution:
8     # 基本树的问题都可以分为递归方法和非递归的方法
9     def Convert(self, pRootOfTree):
10        # write code here
11        # 非递归的方式
12        if not pRootOfTree:
13            return None
14
15        p = pRootOfTree
16
17        stack = []
18        resStack = []
19
20        while p or stack:
21            if p:
22                stack.append(p)
23                p = p.left
24            else:
25                node = stack.pop()
26                resStack.append(node)
27                p = node.right
28
29        resP = resStack[0]
30        while resStack:
31            top = resStack.pop(0)
32            if resStack:
33                top.right = resStack[0]
34                resStack[0].left = top
35        return resP
36
37
```

```
1 # 递归的方法：
2 class Solution:
3     def Convert(self, root):
4         if not root:
5             return None
6         if not root.left and not root.right:
7             return root
8
9         # 将左子树构建为双链表，返回链表头
```

```
10    left = self.Convert(root.left)
11    p = left
12
13    # 定位至左子树的最右的一个结点
14    while left and p.right:
15        p = p.right
16
17    # 如果左子树不为空，将当前root加到左子树链表
18    if left:
19        p.right = root
20        root.left = p
21
22    # 将右子树构造为双链表，返回链表头
23    right = self.Convert(root.right)
24    # 如果右子树不为空，将该链表追加到root结点之后
25    if right:
26        right.left = root
27        root.right = right
28
29    return left if left else root
30
31
32
```

## 27. 字符串的排列

### 题目描述

输入一个字符串,按字典序打印出该字符串中字符的所有排列。例如输入字符串abc,则打印出由字符a,b,c所能排列出来的所有字符串abc,acb,bac,bca,cab和cba。

输入描述:

输入一个字符串,长度不超过9(可能有字符重复),字符只包括大小写字母。

```
1 # -*- coding:utf-8 -*-
2 from itertools import permutations
3 ...
4 # 这个一开始自己写的, 没有通过
5 class Solution:
6     def Permutation(self, ss):
7         # write code here
8         #ll = []
9
10    if not ss:
11        return []
12    # 这个意思是ss是空的意思吗? ?
13    if len(ss)==1:
14        return list(ss)
15    #charList = list(set(''.join(i) for i in permutations(sorted(ss),int(len(ss)))))
16    charList = list(set(''.join(i) for i in permutations(sorted(ss),int(len(ss))))))
17    return charList
18 ...
19
20 import itertools
21 class Solution:
22     def Permutation(self, ss):
23         # write code here
24         result=[]
25         if not ss:
26             return []
27         else:
28             res=itertools.permutations(ss)
29             for i in res:
30                 if ''.join(i) not in result:
31                     result.append(''.join(i))
32     return result
33
34
35
```

```
1
2 class Solution:
3     def Permutation(self, ss):
4         # write code here
5         res = []
6         if len(ss) < 2:
```

```
7      return ss.split()
8  for i in range(len(ss)):
9      for n in map(lambda x: x+ ss[i], self.Permutation(ss[:i]+ss[i+1:])):
10         if n not in res:
11             res.append(n)
12     return sorted(res)
13
```

## 28. 数组中出现次数超过一半的数字

---

### 题目描述

数组中有一个数字出现的次数超过数组长度的一半，请找出这个数字。例如输入一个长度为9的数组{1,2,3,2,2,2,5,4,2}。由于数字2在数组中出现了5次，超过数组长度的一半，因此输出2。如果不存在则输出0。

```
1 # -*- coding:utf-8 -*-
2 from collections import Counter
3 #import collections
4 class Solution:
5     # 典型的 Python 字典计数类型题目
6     def MoreThanHalfNum_Solution(self, numbers):
7         # write code here
8         # 还是用字典的方法去做，可以节约时间复杂度
9         dict = {}
10        for i in numbers:
11            if not dict.has_key(i):
12                dict[i] = 1
13            else:
14                dict[i] = dict[i] + 1
15            if dict[i] > len(numbers)/2:
16                return i
17        return 0
18
```

```
1
2 #方法二，用 collection Counter 函数去做
3 def MoreThanHalfNum_Solution(self, numbers):
4     # write code here
5     from collections import Counter
6     count = Counter(numbers).most_common()
7     if count[0][1] > len(numbers)/2.0:
8         return count[0][0]
9     return 0
10
```

## 29. 最小的K个数

---

### 题目描述

输入n个整数，找出其中最小的K个数。例如输入4,5,1,6,2,7,3,8这8个数字，则最小的4个数字是1,2,3,4。

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     def GetLeastNumbers_Solution(self, tinput, k):
4         # write code here
5         #len1 = len(tinput)
6         # 直接用一下排序算法 sort()
7         tinput.sort()
8         result=[]
9         if k > len(tinput):
10             return []
11         for i in range(k):
12             result.append(tinput[i])
13         return result
```

## 30. 连续子数组的最大和

---

### 题目描述

HZ偶尔会拿些专业问题来忽悠那些非计算机专业的同学。今天测试组开完会后,他又发话了:在古老的一维模式识别中,常常需要计算连续子向量的最大和,当向量全为正数的时候,问题很好解决。但是,如果向量中包含负数,是否应该包含某个负数,并期望旁边的正数会弥补它呢?例如:{6,-3,-2,7,-15,1,2,2},连续子向量的最大和为8(从第0个开始,到第3个为止)。给一个数组,返回它的最大连续子序列的和,你会不会被他忽悠住? (子向量的长度至少是1)

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     def FindGreatestSumOfSubArray(self, array):
4         # write code here
5         # 最大连续子序列的和
6         # 可以用动态规划去做
7         if not array:
8             return False
9         #count = 0
10        cur_sum = 0 # 一个用来存放当前的和
11        max_sum = array[0] # 一个用来存储最大和
12
13        for i in range(len(array)):
14            if cur_sum <= 0:
15                cur_sum = array[i]
16            else:
17                cur_sum += array[i]
18
19            if cur_sum > max_sum:
20                max_sum = cur_sum
21
22        return max_sum
23        ...
24
25        for i in range(len(array)):
26            if array[i]>0:
27                sum1 += array[i]
28                sum1 = max(sum1,maxNum)
29            else:
30                #for j in range
31                maxNum = sum1
32                sum1+=array[i]
33                if sum1 <=0:
34                    sum1 = 0
35        array1 = sorted(array)
36        for j in range(len(array)):
37            if array[i]<0:
38                count++
39            if count == len(array):
40                return array1[0]
41            ...
42
43
```



## 31. 整数中1出现的次数

---

### 题目描述

求出1~13的整数中1出现的次数,并算出100~1300的整数中1出现的次数?为此他特别数了一下1~13中包含1的数字有1、10、11、12、13因此共出现6次,但是对于后面问题他就没辙了。ACMer希望你们帮帮他,并把问题更加普遍化,可以很快的求出任意非负整数区间中1出现的次数(从1到n中1出现的次数)。

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     def NumberOf1Between1AndN_Solution(self, n):
4         # write code here
5         # 先判断n是几位数,
6         count = 0
7         digitL=len(str(n))
8         if n < 1:
9             return 0
10        # 先将数字转成字符串, 然后用len来计算
11        # 直接用一个循环, 自己对自己处理就好了呀
12        for i in range(1,n+1):
13            while i:
14                if i%10==1:
15                    count+=1
16                i=i/10
17        return count
18
19
20
```

## 32. 把数组排成最小的数

---

### 题目描述

输入一个正整数数组，把数组里所有数字拼接起来排成一个数，打印能拼接出的所有数字中最小的一个。例如输入数组{3, 32, 321}，则打印出这三个数字能排成的最小数字为321323。

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     def PrintMinNumber(self, numbers):
4         # write code here
5         #digitL = len(str(numbers))
6         # numbers 是一个正整数数组
7         # 字符串类型相互加减也可以互相比较
8         if not numbers:
9             return ''
10        str_num = [str(m) for m in numbers]
11        # 把每个正整数转成字符串
12        for i in range(len(numbers)-1):
13            for j in range(i+1, len(numbers)):
14                if str_num[i]+str_num[j]>str_num[j]+str_num[i]:
15                    str_num[i], str_num[j] = str_num[j], str_num[i]
16        #return str_num
17        return ''.join(str_num)
18    # join 把list类型转换成字符串类型
19
20    ...
21    用例：
22 [3,5,1,4,2]
23
24 对应输出应该为：
25
26 "12345"
27
28 你的输出为：
29
30 "[['1', '2', '3', '4', '5']]"
31      ...
32
33
34
```

## 33. 丑数 数组判断

---

### 题目描述

把只包含质因子2、3和5的数称作丑数（Ugly Number）。例如6、8都是丑数，但14不是，因为它包含质因子7。习惯上我们把1当做是第一个丑数。求按从小到大的顺序的第N个丑数。

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     def GetUglyNumber_Solution(self, index):
4         # write code here
5         # 重新看一下，反思一下！
6         if index < 1:
7             return 0
8         if 1<=index < 7:
9             return index
10        res=
11        [2**i*3**j*5**k  for i in range(30)  for j in range(20)    for k in range(15)]
12        res.sort()
13        return res[index-1] if index else 0
14    """
15    return sorted([2**i*3**j*5**k  for i in range(30)  for j in range(20)    for k in range(15)])[index-1] if index else 0
16    """
17
18
```

## 34. 第一个只出现一次的字符

---

### 题目描述

在一个字符串(0<=字符串长度<=10000, 全部由字母组成)中找到第一个只出现一次的字符,并返回它的位置,如果没有则返回 -1 (需要区分大小写) .

```
1 # -*- coding:utf-8 -*-
2 from collections import Counter
3 class Solution:
4     def FirstNotRepeatingChar(self, s):
5         # write code here
6         # 判断输入条件
7         if len(s)<=0 or len(s)>10000:
8             return -1
9         # count 用于统计字符串中某个字符的出现个数
10        # index 为计算字符串中某个字符的位置
11        for i in s:
12            if s.count(i)==1:
13                return s.index(i)
14                break
15
16    ...
17 Python: 开始想用字典,但是字典是无序的,所以无法找到第一个出现次数为1
18 的位置
19 我用的是python内置函数完成的,没有提现到算法思想,
20 看到书中是建一个哈希表,以字母的ascii为下标,出现次数为值,然后再遍
21 历一次找到第一个值为1的位置,用python编写如下:
22     #建立哈希表,字符长度为8的数据类型,共有256种可能,于是创建一个长
23 度为256的列表
24     ls=[0]*256
25     #遍历字符串,下标为ASCII值,值为次数
26     for i in s:
27         ls[ord(i)]+=1
28     #遍历列表,找到出现次数为1的字符并输出位置
29     for j in s:
30         if ls[ord(j)]==1:
31             return s.index(j)
32             break
33
34 ...
```

### 35. 数组中的逆序对

## 题目描述

在数组中的两个数字，如果前面一个数字大于后面的数字，则这两个数字组成一个逆序对。输入一个数组，求出这个数组中的逆序对的总数P。并将P对1000000007取模的结果输出。即输出 $P \% 1000000007$

输入描述:

题目保证输入的数组中没有相同的数字

数据范围：

对于%50的数据，size<=10^4

对于%75的数据，size<=10^5

对于%100的数据，size<=2\*10^5

### 示例1

输入

复制

1-2-3-4-5-6-7-0

输出

复制

7

```
1 # -*- coding:utf-8 -*-
2 count = 0
3 class Solution:
4     # re 这道题目要再研究下
5     def InversePairs(self, data):
6         global count
7         # global count 可以节省时间吗？？
8         def MergeSort(lists):
9             # 哪函数定义在函数里面和分开来有什么区别呢？？
10            global count
11            if len(lists) <= 1:
12                return lists
13            num = int(len(lists)/2)
14            left = MergeSort(lists[:num])
15            right = MergeSort(lists[num:])
16            r, l=0, 0
17            result=[]
18            while l<len(left) and r<len(right):
19                if left[l] < right[r]:
20                    result.append(left[l])
21                    l += 1
22                else:
23                    result.append(right[r])
24                    r += 1
25            return result
26
27        count = 0
28        MergeSort(data)
29        print(count)
```

```
22
23
24
25
26
27
28
29
30
31
```

```
    else:
        result.append(right[r])
        r += 1
        count += len(left)-l
    result += right[r:]
    result += left[l:]
return result
MergeSort(data)
return count%1000000007
```

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## 36. 两个链表中的第一个公共节点（链表）

### 题目描述

输入两个链表，找出它们的第一个公共结点。

```
1 # -*- coding:utf-8 -*-
2 class ListNode:
3     def __init__(self, x):
4         self.val = x
5         self.next = None
6 class Solution:
7     """
8     找出2个链表的长度，然后让长的先走两个链表的长度差，然后再一起走
9     (因为2个链表用公共的尾部)
10    """
11
12    # 这个方法为什么不对呢？不是按照那个思路来的吗？
13    def FindFirstCommonNode(self, pHead1, pHead2):
14        len1 = len2 = 0
15        pa = pHead1
16        pb = pHead2
17        while pa!=None:
18            len1 += 1
19            pa.next = pa
20        while pb!=None:
21            len2 += 1
22            pb.next = pb
23        if len1 > len2:
24            while len1 - len2:
25                pHead1 = pHead1.next
26                len1 -= 1
27        elif len2 > len1:
28            while len2 - len1:
29                pHead2 = pHead2.next
30                len2 -= 1
31        while pHead1 and pHead2:
32            if pHead1 == pHead2:
33                return pHead1
34            pHead1 = pHead1.next
35            pHead2 = pHead2.next
36        return None
37
38
```

```
1
2     #方法二：
3 class Solution:
4     def FindFirstCommonNode(self, pHead1, pHead2):
5         if not pHead1 or not pHead2:
6             return None
7
8         stack1 = []
9         stack2 = []
10
```

```
11 while pHead1:  
12     stack1.append(pHead1)  
13     pHead1 = pHead1.next  
14  
15 while pHead2:  
16     stack2.append(pHead2)  
17     pHead2 = pHead2.next  
18  
19 first = None  
20 while stack1 and stack2:  
21     top1 = stack1.pop()  
22     top2 = stack2.pop()  
23     if top1 is top2:  
24         first = top1  
25     else:  
26         break  
27 return first  
28  
29  
30 ...  
31 class Solution:  
32     def FindFirstCommonNode(self, pHead1, pHead2):  
33         # write code here  
34         # 链表的长度不能直接得出，对吧？  
35         # 这样写时间复杂度太大了也不行！  
36         prHead1 = pHead1  
37         prHead2 = pHead2  
38         while prHead1 != None:  
39             while prHead2 !=None:  
40                 if prHead1.val == prHead2.val:  
41                     return prHead1.val  
42                 else:  
43                     continue  
44             #continue  
45         return None  
46 ...
```

## 37. 数字在排序数组中出现的次数

---

### 题目描述

统计一个数字在排序数组中出现的次数。

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     def GetNumber0fK(self, data, k):
4         # write code here
5         # 求k一共有多少次，data是排序好的数组
6         # 成功了！
7         data1 = list(data)
8         count=0
9         for i in range(len(data)):
10             if data[i] == k :
11                 count=count+1
12             else :
13                 continue
14         return count
```

## 38. 二叉树的深度（树）

---

### 题目描述

输入一棵二叉树，求该树的深度。从根结点到叶结点依次经过的结点（含根、叶结点）形成树的一条路径，最长路径的长度为树的深度。

```
1 # -*- coding:utf-8 -*-
2 class TreeNode:
3     def __init__(self, x):
4         self.val = x
5         self.left = None
6         self.right = None
7 class Solution:
8     # 还需要理解一下递归的用法！！！
9     def TreeDepth(self, pRoot):
10        # write code here
11        if pRoot == None:
12            return 0
13        count = max(self.TreeDepth(pRoot.left), self.TreeDepth(pRoot.right))+1
14        return count
15
16
17
```

## 39. 平衡二叉树（树）

### 题目描述

输入一棵二叉树，判断该二叉树是否是平衡二叉树。

```
1 # -*- coding:utf-8 -*-
2 class TreeNode:
3     def __init__(self, x):
4         self.val = x
5         self.left = None
6         self.right = None
7 class Solution:
8     """
9         如果二叉树的每个节点的左子树和右子树的深度不大于1，它就是平衡
10        二叉树。
11        先写一个求深度的函数，再对每一个节点判断，看该节点的左子树的深
12        度和右子树的深度的差是否大于1
13        """
14        # write code here
15        # 平衡二叉树是一棵空树或它的左右两个子树的高度差的绝对值
16        不超过1，
17        # 并且左右两个子树都是一棵平衡二叉树。
18    def IsBalanced_Solution(self, root):
19        if not root:
20            return True
21        if abs(self.maxDepth(root.left) - self.maxDepth(root.right)) > 1:
22            return False
23        return self.IsBalanced_Solution(root.left) and self.IsBalanced_Solution(root.rig
24        ht)
25
26        def maxDepth(self, root):
27            if not root: return 0
28            return max(self.maxDepth(root.left), self.maxDepth(root.right)) + 1
```

```
1
2
3 #方法二：自下而上，时间复杂度O(N)
4 class Solution:
5     def IsBalanced_Solution(self, p):
6         return self.dfs(p) != -1
7     def dfs(self, p):
8         if p is None:
9             return 0
10        left = self.dfs(p.left)
11        if left == -1:
12            return -1
13        right = self.dfs(p.right)
14        if right == -1:
15            return -1
16        if abs(left - right) > 1:
17            return -1
18        return max(left, right) + 1
```



## 40. 数组中只出现一次的数字

### 题目描述

一个整型数组里除了两个数字之外，其他的数字都出现了两次。请写程序找出这两个只出现一次的数字。

### 示例1

输入

复制

输出

复制

```
1 # -*- coding:utf-8 -*-
2 from collections import Counter
3 class Solution:
4     # 返回 [a,b] 其中 ab 是 出现一 次 的 两 个 数 字
5     def FindNumsAppearOnce(self, array):
6         # write code here
7         #mylist = list(array)
8         #return Counter(mylist).keys() if Counter(mylist).values()==1
9         # 需要更熟悉一些 lamda 函数 的 用 法
10        return list(map(lambda c: c[0],Counter(array).most_common()[-2:]))
11        # 为 什 么 最 后 两 个 数 是 这 种 写 法 啊 ？ ？ ？ 为 什 么 不 是 -2 -1
12
13
14
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```

### 41. 和为S的连续正数序列

## 题目描述

小明很喜欢数学,有一天他在做数学作业时,要求计算出9~16的和,他马上就写出了正确答案是100。但是他并不满足于此,他在想究竟有多少种连续的正数序列的和为100(至少包括两个数)。没多久,他就得到另一组连续正数和为100的序列:18,19,20,21,22。现在把问题交给你,你能不能也很快的找出所有和为S的连续正数序列?  
Good Luck!

输出描述:

输出所有和为s的连续正数序列。序列内按照从小至大的顺序，序列间按照开始数字从小到大的顺序

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     def FindContinuousSequence(self, tsum):
4         # write code here
5         # 找出所有和为S的连续正数序列
6         res=[]
7         for i in range(1,tsum//2+1):
8             sumRes=i
9             for j in range(i+1,tsum//2+2):
10                 sumRes+=j
11                 if sumRes==tsum:
12                     res.append(list(range(i,j+1)))
13                     break
14                 elif sumRes>tsum:
15                     break
16         return res
```

## 42. 和为S的两个数字

---

### 题目描述

输入一个递增排序的数组和一个数字S，在数组中查找两个数，使得他们的和正好是S，如果有对数字的和等于S，输出两个数的乘积最小的。

输出描述：

对应每个测试案例，输出两个数，小的先输出。

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     def FindNumbersWithSum(self, array, tsum):
4         # write code here
5         #for i in range(len(array)):
6         i = 0
7         j = len(array)-1
8         result = []
9         while i < j:
10             if array[i]+array[j]<tsum:
11                 i+=1
12             elif array[i]+array[j]>tsum:
13                 j-=1
14             else:
15                 #return [i,j]
16                 result.append(array[i])
17                 result.append(array[j])
18                 return result
19                 #return [array[i],array[j]]
20
21         return []
```

## 43. 左旋转字符串

---

### 题目描述

汇编语言中有一种移位指令叫做循环左移（ROL），现在有个简单的任务，就是用字符串模拟这个指令的运算结果。对于一个给定的字符序列S，请你把其循环左移K位后的序列输出。例如，字符序列S="abcXYZdef"，要求输出循环左移3位后的结果，即“XYZdefabc”。是不是很简单？OK，搞定它！

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     def LeftRotateString(self, s, n):
4         # write code here
5         # python字符串操作的题目，是全部转化为list做还是什么？---对的
6         ,然后再用join转为字符串
7             return s[n:]+s[:n] # 方法一，太秀了

1 # 方法二：常规方法
2     if not s:
3         return ""
4     l=list(s)
5     m=len(l)
6     a=[]
7     for i in range(m):
8         if i+n<m:
9             a.append(l[i+n])
10    for j in range(n):
11        a.append(l[j])
12    return ''.join(a)
```

## 44. 翻转单词顺序列

## 题目描述

牛客最近来了一个新员工Fish，每天早晨总是会拿着一本英文杂志，写些句子在本子上。同事Cat对Fish写的内容颇感兴趣，有一天他向Fish借来翻看，但却读不懂它的意思。例如，“student. a am I”。后来才意识到，这家伙原来把句子单词的顺序翻转了，正确的句子应该是“*I am a student.*”。Cat对一一的翻转这些单词顺序可不在行，你能帮助他么？

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     def ReverseSentence(self, s):
4         # write code here
5         # 根据空格的位置做分割
6         # 用空格做分割，把这些单词装到矩阵里面去
7         return " ".join(s.split(" ")[::-1])# 方法一，最简单直接的方法
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```

## 45. 扑克牌顺子

---

### 题目描述

LL今天心情特别好,因为他去买了一副扑克牌,发现里面居然有2个大王,2个小王(一副牌原本是54张^\_^)...他随机从中抽出了5张牌,想测测自己的手气,看看能不能抽到顺子,如果抽到的话,他决定去买体育彩票,嘿嘿!!“红心A,黑桃3,小王,大王,方片5”,“Oh My God!”不是顺子.....LL不高兴了,他想了想,决定大小王可以看成任何数字,并且A看作1,J为11,Q为12,K为13。上面的5张牌就可以变成“1,2,3,4,5”(大小王分别看作2和4),“So Lucky!”。LL决定去买体育彩票啦。现在,要求你使用这幅牌模拟上面的过程,然后告诉我们LL的运气如何, 如果牌能组成顺子就输出true, 否则就输出false。为了方便起见,你可以认为大小王是0。

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     def IsContinuous(self, numbers):
4         # write code here
5         ...
6 1、如果输入为空，返回 false
7 2、除了王的任何某个特定数值的牌出现两张或者更多，那么一定凑不齐
8 顺子。
9 思路，先统计王的数量，再把牌排序，如果后面一个数比前面一个数大
10 于1以上，那么中间的差值就必须用王来补了。看王的数量够不够，如果
11 够就返回 true，否则返回 false。
12 ...
13     if not numbers:
14         return False
15     numbers.sort()
16     zeroNum = numbers.count(0)
17     for i, v in enumerate(numbers[:-1]):
18         if v != 0:
19             if numbers[i+1]==v: return False
20             zeroNum = zeroNum - (numbers[i + 1] - v) + 1
21             if zeroNum < 0:
22                 return False
23     return True
```

## 46. 孩子们的游戏（圆圈中最后剩下的数）

### 题目描述

每年六一儿童节,牛客都会准备一些小礼物去看望孤儿院的小朋友,今年亦是如此。HF作为牛客的资深元老,自然也准备了一些小游戏。其中,有个游戏是这样的:首先,让小朋友们围成一个大圈。然后,他随机指定一个数m,让编号为0的小朋友开始报数。每次喊到m-1的那个小朋友要出列唱首歌,然后可以在礼品箱中任意的挑选礼物,并且不再回到圈中,从他的下一个小朋友开始,继续0...m-1报数....这样下去....直到剩下最后一个小朋友,可以不用表演,并且拿到牛客名贵的“名侦探柯南”典藏版(名额有限哦!!^\_^)。请你试着想下,哪个小朋友会得到这份礼品呢? (注: 小朋友的编号是从0到n-1)

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     def LastRemaining_Solution(self, n, m):
4         # write code here
5         # 对小朋友进行编号, 从0到n-1
6         # 典型题, 约瑟夫问题, 求递推公式, 每轮的序列中最后出序列的
数都是同一个
7
8         # 方法一, 非递归方法
9         if n < 1:
10             return -1
11
12         con = range(n)
13
14         final = -1
15         start = 0
16         while con:
17             k = (start + m - 1) % n
18             final = con.pop(k)
19             n -= 1
20             start = k
21
22         return final
23
24
```

```
1
2     # 递归问题特别耗内存, 这个问题到一定程度就超出界限了, 所以
谨慎使用递归方法
3     if n < 1:
4         return -1
5     if n == 1:
6         return 0
7     return (self.LastRemaining_Solution(n-1,m)+m)%n
8
9
```

47. 求 $1+2+3+\dots+n$

## 题目描述

求 $1+2+3+\dots+n$ , 要求不能使用乘除法、for、while、if、else、switch、case等关键字及条件判断语句 (A?B:C)。

## 48. 不用加减乘除做加法

---

### 题目描述

写一个函数，求两个整数之和，要求在函数体内不得使用+、-、\*、/四则运算符号。

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     def Add(self, num1, num2):
4         # write code here
5         # 这个是只能用位运算了吗？
6         #return sum([num1,num2])#方法一
7         #方法二，Python对位操作支持不是很友好，主要原因还是因为
8         #python没有无符号又移操作，所以需要越界检查一波～
9         #其他思路和大家是一样的，加法是异或，进位是与<<1
10        while(num2):
11            num1, num2 = (num1^num2) & 0xFFFFFFFF, ((num1&num2)<<1) & 0xFFFFFFFF
12            return num1 if num1<=0x7FFFFFFF else ~(num1^0xFFFFFFFF)
13
14        ...
15
16    1. 两个数异或：相当于每一位相加，而不考虑进位；
17    2. 两个数相与，并左移一位：相当于求得进位；
18    3. 将上述两步的结果相加
19    public int Add(int num1,int num2) {
20        while( num2!=0 ){
21            int sum = num1 ^ num2;
22            int cararry = (num1 & num2) << 1;
23            num1 = sum;
24            num2 = cararry;
25        }
26        return num1;
27    }
28    ...
29
```

## 49. 把字符串转换为整数

### 题目描述

将一个字符串转换成一个整数(实现Integer.valueOf(string)的功能，但是string不符合数字要求时返回0)，要求不能使用字符串转换整数的库函数。 数值为0或者字符串不是一个合法的数值则返回0。

### 输入描述:

输入一个字符串,包括数字字母符号,可以为空

### 输出描述:

如果是合法的数值表达则返回该数字, 否则返回0

### 示例1

#### 输入

复制

```
+2147483647  
1a33
```

#### 输出

复制

```
2147483647  
0
```

```
1 # -*- coding:utf-8 -*-  
2 class Solution:  
3     def StrToInt(self, s):  
4         # write code here  
5         # re 参考了答案  
6         numlist=['0','1','2','3','4','5','6','7','8','9','+','-']  
7         sum=0  
8         label=1# 正负数标记  
9         if s=='':  
10             return 0  
11         for string in s:  
12             if string in numlist:# 如果是合法字符  
13                 if string=='+'.  
14                     label=1  
15                     continue  
16                 elif string=='-':  
17                     label=-1
```

```
18         continue
19     else:
20         sum=sum*10+numlist.index(string)
21         # 把 string 类型 转 换 为 int 类
22     if string not in numlist:#非 合 法 字 符
23         sum=0
24     break#跳 出 循 环
25 return sum*label
```

笔记

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## 50. 数组中重复的数字

### 题目描述

在一个长度为n的数组里的所有数字都在0到n-1的范围内。数组中某些数字是重复的，但不知道有几个数字是重复的。也不知道每个数字重复几次。请找出数组中任意一个重复的数字。例如，如果输入长度为7的数组{2,3,1,0,2,5,3}，那么对应的输出是第一个重复的数字2。

### 示例1

输入

复制

输出

复制

```
1 # -*- coding:utf-8 -*-
2 from collections import Counter
3 class Solution:
4     # 这里要特别注意~找到任意重复的一个值并赋值到duplication[0]
5     # 函数返回True/False
6     def duplicate(self, numbers, duplication):
7         # write code here
8         cur = 0
9         while cur < len(numbers):
10             if numbers[cur] == cur:
11                 cur += 1
12                 continue
13
14             if numbers[cur] == numbers[numbers[cur]]:
15                 duplication[0] = numbers[cur]
16                 return True
17
18             # 注意这里不能直接multiple assignment
19             temp = numbers[cur]
20             numbers[cur] = numbers[numbers[cur]]
21             numbers[temp] = temp
22         return False
23
24     ...
25     # 时间复杂度太大了，是O(N2)了
26     def duplicate(self, numbers, duplication):
27         # write code here
28         #duplication = True
29         Myarray = []
30         for i in range(0, len(numbers)-1):
31             for j in range(i+1, len(numbers)):
32                 if numbers[j]==numbers[i]:
33                     duplication[0] = numbers[i]
```

```
34      return True  
35  return False  
36  ...  
37  
38  
39
```

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## 51. 构建乘积数组

---

### 题目描述

给定一个数组A[0,1,...,n-1],请构建一个数组B[0,1,...,n-1],其中B中的元素 $B[i]=A[0]*A[1]*...*A[i-1]*A[i+1]*...*A[n-1]$ 。不能使用除法。

```
1 # -*- coding:utf-8 -*-
2 import copy
3 class Solution:
4     def multiply(self, A):
5         # write code here
6         # 直接先算A数组的从头到尾的数值
7         # 最后得出sum的乘积的值
8         # 这是时间复杂度小一点的方法一
9         B=[1]*len(A)
10        for i in range(len(A)):
11            C=copy.copy(A)
12            C.pop(i)
13            for j in range(len(C)):
14                B[i]*=C[j]
15        return B
16        ...
17        # 方法二：很容易想到，但是这种方法时间复杂度大了一点
18        B = []
19        for i in range(len(A)):
20            sum = 1
21            for j in range(0,i):
22                sum = sum * A[j]
23            for j in range(i+1,len(A)):
24                sum = sum * A[j]
25            B.append(sum)
26        return B
27        ...
```

## 52. 正则表达式匹配

### 题目描述

请实现一个函数用来匹配包括'.'和'\*'的正则表达式。模式中的字符'.'表示任意一个字符，而'\*'表示它前面的字符可以出现任意次（包含0次）。在本题中，匹配是指字符串的所有字符匹配整个模式。例如，字符串"aaa"与模式"a.a"和"ab\*ac\*a"匹配，但是与"aa.a"和"ab\*a"均不匹配

```
1 # -*- coding:utf-8 -*-
2 import re
3 class Solution:
4     # 好 难 啊， 研究 下 正 则 表 达 式
5     # s, pattern 都 是 字 符 串
6     def match(self, s, pattern):
7         def fullmatch(regex, string, flags=0):
8             return re.match("(?:" + regex + r")\Z", string, flags=flags)
9         return True if fullmatch(pattern,s) else False
10
11
12 ...
13 # -*- coding:utf-8 -*-
14
15 题 目： 请 实 现 一 个 函 数 用 来 匹 配 包 括 ‘.’ 和 ‘*’ 的 正 则 表 达 式 。
16 模 式 中 的 字 符 ‘.’ 表 示 任 意 一 个 字 符 （ 不 包 括 空 字 符 ！ ） ， 而 ‘*’ 表 示 它 前
17 面 的 字 符 可 以 出 现 任 意 次 （ 包 含 0 次 ） 。
18 在 本 题 中 ， 匹 配 是 指 字 符 串 的 所 有 字 符 匹 配 整 个 模 式 。 例 如 ， 字 符 串 "aaa"
19 与 模 式 "a.a" 和 "ab*ac*a" 匹 配 ， 但 是 与 "aa.a" 和 "ab*a" 均 不 匹 配
20
21 class Solution:
22     # s, pattern 都 是 字 符 串
23     def match(self, s, pattern):
24         # 如 果 s 与 pattern 都 为 空 ， 则 True
25         if len(s) == 0 and len(pattern) == 0:
26             return True
27         # 如 果 s 不 为 空 ， 而 pattern 为 空 ， 则 False
28         elif len(s) != 0 and len(pattern) == 0:
29             return False
30         # 如 果 s 为 空 ， 而 pattern 不 为 空 ， 则 需 要 判 断
31         elif len(s) == 0 and len(pattern) != 0:
32             # pattern 中 的 第 二 个 字 符 为 * ， 则 pattern 后 移 两 位 继 续 比 较
33             if len(pattern) > 1 and pattern[1] == '*':
34                 return self.match(s, pattern[2:])
35             else:
36                 return False
37         # s 与 pattern 都 不 为 空 的 情 况
38         else:
39             # pattern 的 第 二 个 字 符 为 * 的 情 况
40             if len(pattern) > 1 and pattern[1] == '*':
41                 # s 与 pattern 的 第 一 个 元 素 不 同 ， 则 s 不 变 ， pattern 后 移 两 位 ，
42                 # 相 当 于 pattern 前 两 位 当 成 空
43                 if s[0] != pattern[0] and pattern[0] != '.':
44                     return self.match(s, pattern[2:])
45                 else:
46                     # 如 果 s[0] 与 pattern[0] 相 同 ， 且 pattern[1] 为 * ， 这 个 时 候 有
```

三种情况

44                          # pattern后移2个，s不变；相当于把pattern前两位当成空，  
45                          # pattern后移2个，s后移1个；相当于pattern前两位与s[0]匹  
配  
46                          # pattern不变，s后移1个；相当于pattern前两位，与s中的  
多位进行匹配，因为\*可以匹配多位  
47                          return self.match(s, pattern[2:]) or self.match(s[1:], pattern[2:])  
or self.match(s[1:], pattern)  
48                          # pattern第二个字符不为\*的情况  
49                          else:  
50                          if s[0] == pattern[0] or pattern[0] == '.':  
51                          return self.match(s[1:], pattern[1:])  
52                          else:  
53                          return False  
54                          ...  
55                          ...  
56                          ...  
57       解这题需要把题意仔细研究清楚，反正我试了好多次才明白的。  
58       首先，考虑特殊情况：  
59       1>两个字符串都为空，返回true  
60       2>当第一个字符串不空，而第二个字符串空了，返回false（因为这样，就无法  
61       匹配成功了，而如果第一个字符串空了，第二个字符串非空，还是可能匹配成  
62       功的，比如第二个字符串是"aka\*a\*a\*",由于'\*'之前的元素可能出现0次，  
63       所以有可能匹配成功）  
64       之后就开始匹配第一个字符，这里有两种可能：匹配成功或匹配失败。  
但考虑到pattern  
65       下一个字符可能是'\*'，这里我们分两种情况讨论：pattern下一个字符  
为'\*'或  
66       不为'\*'：  
67       1>pattern下一个字符不为'\*'：这种情况比较简单，直接匹配当前  
字符。如果  
68       匹配成功，继续匹配下一个；如果匹配失败，直接返回false。  
注意这里的  
69       "匹配成功"，除了两个字符相同的情况外，还有一种情况，就是pattern的  
70       当前字符为'.'，同时str的当前字符不为'\0'。  
71       2>pattern下一个字符为'\*'时，稍微复杂一些，因为'\*'可以代表0个  
或多个。  
72       这里把这些情况都考虑到：  
73       a>当'\*'匹配0个字符时，str当前字符不变，pattern当前字符后  
移两位，  
74       跳过这个'\*'符号；  
75       b>当'\*'匹配1个或多个时，str当前字符移向下一个，pattern当前字符  
前字符  
76       不变。（这里匹配1个或多个可以看成一种情况，因为：当  
匹配一个时，  
77       由于str移到了下一个字符，而pattern字符不变，就回到了上  
边的情况a；  
78       当匹配多于一个字符时，相当于从str的下一个字符继续开始匹  
配）  
79       之后再写代码就很简单了。  
80       ...  
81  
82  
83  
84



## 53. 表示数值的字符串

## 题目描述

请实现一个函数用来判断字符串是否表示数值（包括整数和小数）。例如，字符串"+100","5e2",-123","3.1416"和"-1E-16"都表示数值。但是"12e","1a3.14","1.2.3","+ -5"和"12e+4.3"都不是。

```
44         elif s[i] == '.':
45             # 小数点不能出现两次；而且如果已经出现过e了，那么就不能再出现小数点，因为e后面只能是整数
46             if has_point or has_e:
47                 return False
48             # 如果是第一次出现小数点，如果前面出现过e，那么还是不能出现小数点
49             else:
50                 has_point = True
51                 if i > 0 and (s[i-1] == 'e' or s[i-1] == 'E'):
52                     return False
53             else:
54                 # 其他字符必须是'0'到'9'之间的
55                 if s[i] < '0' or s[i] > '9':
56                     return False
57             return True
58
59
60
```

## 54. 字符流中第一个不重复的字符

## 题目描述

请实现一个函数用来找出字符流中第一个只出现一次的字符。例如，当从字符流中只读出前两个字符"go"时，第一个只出现一次的字符是"g"。当从该字符流中读出前六个字符“google”时，第一个只出现一次的字符是"l"。

输出描述:

如果当前字符流没有存在出现一次的字符，返回#字符。

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     # 返回对应char
4     # 还没有看懂，回头研究下
5     def __init__(self):
6         self.char_list = [-1 for i in range(256)]
7         self.index = 0 # 记录当前字符的个数，可以理解为输入的字符串中
8         的下标
9     def FirstAppearingOnce(self):
10        # write code here
11        # 对于字符流的处理是和字符串一样的吗？？
12        min_value = 500
13        min_idx = -1
14        for i in range(256):
15            if self.char_list[i] > -1:
16                if self.char_list[i] < min_value:
17                    min_value = self.char_list[i]
18                    min_idx = i
19        if min_idx > -1:
20            return chr(min_idx)
21        else:
22            return '#'
23
24    def Insert(self, char):
25        # write code here
26    # 如果是第一次出现，则将对应元素的值改为下边
27    if self.char_list[ord(char)] == -1:
28        self.char_list[ord(char)] = self.index
29    # 如果已经出现过两次了，则不修改
30    elif self.char_list[ord(char)] == -2:
31        pass
32    # 如果出现过一次，则进行修改，修改为-2
33    else:
34        self.char_list[ord(char)] = -2
35    self.index += 1
36
```

```
4
5 def __init__(self):
6     self.s=""
7 def FirstAppearingOnce(self):
8
9     res=list(filter(lambda c:self.s.count(c)==1,self.s))
10    return res[0] if res else "#"
11
12 def Insert(self, char):
13
14     self.s+=char
15
16
17
18
```

## 55. 链表中环的入口结点

---

### 题目描述

给一个链表，若其中包含环，请找出该链表的环的入口结点，否则，输出null。

```
1 # -*- coding:utf-8 -*-
2 class ListNode:
3     def __init__(self, x):
4         self.val = x
5         self.next = None
6 class Solution:
7     def EntryNodeOfLoop(self, pHead):
8         # write code here
9         # 链表中环的处理
10        # 多写几道关于链表的题目！！！
11        slow, fast=pHead, pHead
12        while fast and fast.next:
13            slow=slow.next
14            fast=fast.next.next
15            if slow==fast:
16                slow2=pHead
17                while slow!=slow2:
18                    slow=slow.next
19                    slow2=slow2.next
20                return slow
21
22    #return None
23
24
```

## 56. 删除链表中重复的结点

---

### 题目描述

在一个排序的链表中，存在重复的结点，请删除该链表中重复的结点，重复的结点不保留，返回链表头指针。例如，链表1->2->3->3->4->4->5 处理后为 1->2->5

```
1 # -*- coding:utf-8 -*-
2 class ListNode:
3     def __init__(self, x):
4         self.val = x
5         self.next = None
6 class Solution:
7     def deleteDuplication(self, pHead):
8         # write code here
9         # 方法一，最常规的做法，必须掌握！！！
10        # 这道题目应该不好用递归去写！
11        if pHead == None or pHead.next == None:
12            return pHead
13        # 新建一个链表
14        # 和那道反转链表用的方法是差不多的
15        new_head = ListNode(-1)
16        new_head.next = pHead
17        pre = new_head
18        p = pHead
19        nex = None
20        while p != None and p.next != None:
21            nex = p.next
22            if p.val == nex.val:
23                while nex != None and nex.val == p.val:
24                    nex = nex.next
25                pre.next = nex
26                p = nex
27            else:
28                pre = p
29                p = p.next
30        return new_head.next
31
32
```

```
1
2 # 新建一个链表返回
3 def deleteDuplication(self, pHead):
4     res = []
5     while pHead:
6         res.append(pHead.val)
7         pHead = pHead.next
8     res = list(filter(lambda c: res.count(c) == 1, res))
9     dummy = ListNode(0)
10    pre = dummy
11    for i in res:
12        node = ListNode(i)
13        pre.next = node
14        pre = pre.next
```

```
15  
16  
17  
18  
19  
  
    return dummy.next
```

## 57. 二叉树的下一个结点 (树)

---

### 题目描述

给定一个二叉树和其中的一个结点，请找出中序遍历顺序的下一个结点并且返回。注意，树中的结点不仅包含左右子结点，同时包含指向父结点的指针。

```
1 # -*- coding:utf-8 -*-
2 class TreeLinkNode:
3     def __init__(self, x):
4         self.val = x
5         self.left = None
6         self.right = None
7         self.next = None
8 class Solution:
9     # 重新看一下题目的解答
10    def GetNext(self, pNode):
11        # write code here
12        if pNode.right:#有右子树
13            p=pNode.right
14            while p.left:
15                p=p.left
16            return p
17        while pNode.next:#无右子树，则找第一个当前节点是父节点左孩子的
18            if(pNode.next.left==pNode):
19                return pNode.next
20            pNode = pNode.next#沿着父节点向上遍历
21        return #到了根节点仍没找到，则返回空
22
23
24
```

节点

## 58. 对称的二叉树

---

### 题目描述

请实现一个函数，用来判断一颗二叉树是不是对称的。注意，如果一个二叉树同此二叉树的镜像是同样的，定义其为对称的。

```
1 # -*- coding:utf-8 -*-
2 class TreeNode:
3     def __init__(self, x):
4         self.val = x
5         self.left = None
6         self.right = None
7 class Solution:
8     # 递归比较左右节点，然后对左右节点的左右分支进一步递归比较
9     def isSymmetrical(self, pRoot):
10         if not pRoot:
11             return True
12         return self.compare(pRoot.left, pRoot.right)
13
14     def compare(self, pRoot1, pRoot2):
15         if not pRoot1 and not pRoot2:
16             return True
17         if not pRoot1 or not pRoot2:
18             return False
19         if pRoot1.val == pRoot2.val:
20             if self.compare(pRoot1.left, pRoot2.right) and self.compare(pRoot1.right, pR
oot2.left):
21                 return True
22             return False
23
24
25
26
```

## 59. 按之字形顺序打印二叉树 (树)

---

### 题目描述

请实现一个函数按照之字形打印二叉树，即第一行按照从左到右的顺序打印，第二层按照从右至左的顺序打印，第三行按照从左到右的顺序打印，其他行以此类推。

```
1 # -*- coding:utf-8 -*-
2 class TreeNode:
3     def __init__(self, x):
4         self.val = x
5         self.left = None
6         self.right = None
7 class Solution:
8     def Print(self, pRoot):
9         if not pRoot:
10             return []
11         nodeStack=[pRoot]
12         result=[]
13         while nodeStack:
14             res = []
15             nextStack=[]
16             for i in nodeStack:
17                 res.append(i.val)
18                 if i.left:
19                     nextStack.append(i.left)
20                 if i.right:
21                     nextStack.append(i.right)
22             nodeStack=nextStack
23             result.append(res)
24         returnResult=[]
25         for i,v in enumerate(result):
26             if i%2==0:
27                 returnResult.append(v)
28             else:
29                 returnResult.append(v[::-1])
30         return returnResult
31
32
```

## 60. 把二叉树打印成多行 (树)

---

### 题目描述

从上到下按层打印二叉树，同一层结点从左至右输出。每一层输出一行。

```
1 # -*- coding:utf-8 -*-
2 class TreeNode:
3     def __init__(self, x):
4         self.val = x
5         self.left = None
6         self.right = None
7 class Solution:
8     # 返回二维列表 [[1,2],[4,5]]
9     # 看的别人的答案
10
11    def Print(self, pRoot):
12        if not pRoot:
13            return []
14        nodeStack = [pRoot]
15        result = []
16        while nodeStack:
17            res = []
18            nextStack = []
19            for i in nodeStack:
20                res.append(i.val)
21                if i.left:
22                    nextStack.append(i.left)
23                if i.right:
24                    nextStack.append(i.right)
25            nodeStack = nextStack
26            result.append(res)
27        return result
28
29
30
31
32        ...
33
34    用例：
35    {8,6,10,5,7,9,11}
36
37    对应输出应该为：
38    [[8],[6,10],[5,7,9,11]]
39        ...
40
```

## 61. 序列化二叉树（树）

### 题目描述

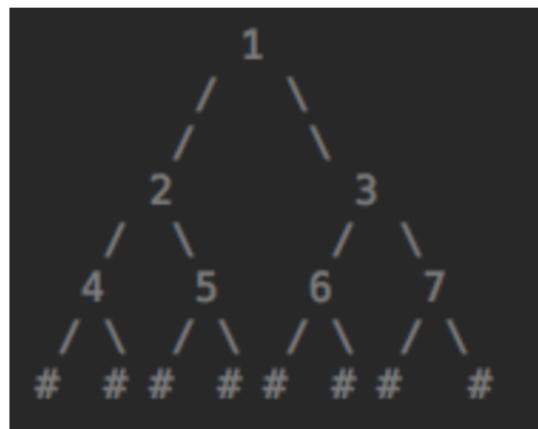
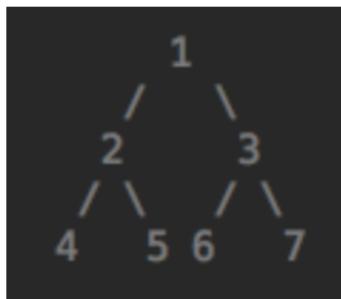
请实现两个函数，分别用来序列化和反序列化二叉树

### 解题思路

序列化二叉树：把一棵二叉树按照某种遍历方式的结果以某种格式保存为字符串。需要注意的是，序列化二叉树的过程中，如果遇到空节点，需要以某种符号（这里用#）表示。以下图二叉树为例，序列化二叉树时，需要将空节点也存入字符串中。



序列化可以基于先序/中序/后序/按层等遍历方式进行，这里采用先序遍历的方式实现，字符串之间用“，”隔开。代码如下：



```
1 def Serialize(self, root):
2     if not root:
3         return '#'
4     return str(root.val) + ',' + self.Serialize(root.left) + ',' + self.Serialize(root.right)
5 ...
6 反序列化二叉树：根据某种遍历顺序得到的序列化字符串，重构二叉树。
7 具体思路是按前序遍历“根左右”的顺序，根节点位于其左右子节点的前面，即非空（#）的第一个节点是某子树的根节点，左右子节点在该根节点后，以空节点#为分隔符。代码如下：
8 ...
9 def Deserialize(self, s):
10    list = s.split(',')
11    return self.deserializeTree(list)
12 ...
13 def deserializeTree(self, list):
14    if len(list)<=0:
15        return None
16    val = list.pop(0)
17    root = None
```

```

17     if val != '#':
18         root = TreeNode(int(val))
19         root.left = self.deserializeTree(list)
20         root.right = self.deserializeTree(list)
21     return root
22

1 # -*- coding:utf-8 -*-
2 class TreeNode:
3     def __init__(self, x):
4         self.val = x
5         self.left = None
6         self.right = None
7 # 没有看懂，研究别人的代码！！！
8 # 见收藏夹里的一个CSDN博客
9
10 class Solution:
11     def Serialize(self, root):
12         """前序递归"""
13         ret = []
14         if not root:
15             return '#'
16         ret.append(str(root.val))
17         l = self.Serialize(root.left)
18         ret.append(l)
19         r = self.Serialize(root.right)
20         ret.append(r)
21         return ','.join(ret)
22
23     def Serialize_no_rec(self, root):
24         """前序非递归"""
25         serialize_str = []
26         if not root:
27             return '#'
28         s = []
29         while root or s:
30             while root:
31                 # serialize_str += (str(root.val)+',')
32                 serialize_str.append(str(root.val))
33                 s.append(root.right) # 栈中存放右结点，便于左子树访问完之后回溯
34                 root = root.left
35             # serialize_str += "#,"
36             serialize_str.append('#') # 左结点访问完，用#来标识该结点的空指针
37             root = s.pop() # 依次访问栈中的右子树 # print serialize_str
38         return ','.join(serialize_str)
39
40
41     def Deserialize(self, s):
42         serialize = s.split(',')
43         tree, sp = self.deserialize(serialize, 0)
44         return tree
45
46     def deserialize(self, s, sp):
47         if sp >= len(s) or s[sp] == "#":
48             return None, sp + 1
49         node = TreeNode(int(s[sp]))
50         sp += 1
51         node.left, sp = self.deserialize(s, sp)
52         node.right, sp = self.deserialize(s, sp)

```

```
53  
54     return node, sp  
55
```

## 62. 二叉搜索树的第k个节点

---

### 题目描述

给定一棵二叉搜索树，请找出其中的第k小的结点。例如，`(5, 3, 7, 2, 4, 6, 8)` 中，按结点数值大小顺序第三小结点的值为4。

```
1 # -*- coding:utf-8 -*-
2 class TreeNode:
3     def __init__(self, x):
4         self.val = x
5         self.left = None
6         self.right = None
7 class Solution:
8     # 返回对应节点TreeNode
9     # 这种树的题目非常重要！！！
10    def KthNode(self, pRoot, k):
11        # write code here
12        # 要注意，返回的是节点，而不是节点的值
13        # 树的题目普遍牵涉到递归！
14        self.res=[]
15        self.dfs(pRoot)# 只有用self才能在不同函数中通用
16        if 0<k<=len(self.res):
17            return self.res[k-1]
18        else:
19            return None
20
21    # 中序遍历，输出第k个节点
22    def dfs(self,root):
23        if not root:
24            return
25        # 中序遍历，先打印左节点，后打印中节点，最后打印右节点
26        self.dfs(root.left)
27        self.res.append(root)
28        self.dfs(root.right)
29
30
31
32
```

## 63. 数据流中的中位数

---

### 题目描述

如何得到一个数据流中的中位数？如果从数据流中读出奇数个数值，那么中位数就是所有数值排序之后位于中间的数值。如果从数据流中读出偶数个数值，那么中位数就是所有数值排序之后中间两个数的平均值。我们使用Insert()方法读取数据流，使用GetMedian()方法获取当前读取数据的中位数。

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     # 重新看题目，总结！
4     def __init__(self):
5         self.arr=[]
6     def Insert(self, num):
7         self.arr.append(num)
8         self.arr.sort()
9     def GetMedian(self, shabi):
10        length=len(self.arr)
11        if length%2==1:
12            return self.arr[length//2]
13        return (self.arr[length//2]+self.arr[length//2-1])/2.0
14
15    ...
16    用例：如果没有那个shabi的话，就是如下
17 [5,2,3,4,1,6,7,0,8]
18
19 对应输出应该为：
20
21 "5.00 3.50 3.00 3.50 3.00 3.50 4.00 3.50 4.00 "
22
23 你的输出为：
24
25 GetMedian() takes exactly 1 argument (2 given)
26    ...
```

## 64. 滑动窗口的最大值

### 题目描述

给定一个数组和滑动窗口的大小，找出所有滑动窗口里数值的最大值。例如，如果输入数组{2,3,4,2,6,2,5,1}及滑动窗口的大小3，那么一共存在6个滑动窗口，他们的最大值分别为{4,4,6,6,6,5}；针对数组{2,3,4,2,6,2,5,1}的滑动窗口有以下6个： {[2,3,4],2,6,2,5,1}, {2,[3,4,2],6,2,5,1}, {2,3,[4,2,6],2,5,1}, {2,3,4,[2,6,2],5,1}, {2,3,4,2,[6,2,5],1}, {2,3,4,2,6,[2,5,1]}。

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     def maxInWindows(self, num, size):
4         # write code here
5         # 有没有复杂度低一些的算法???
6         # 解法一，时间复杂度低一些
7         res, i = [], 0
8         while size > 0 and i + size - 1 < len(num):
9             res.append(max(num[i:i + size]))
10            i += 1
11        return res
```

```
1
2     # 方法二：比较好想，时间复杂度高了，也是可行的
3     Mymatrix = []
4     num_len = len(num)
5     B = []
6     if size == 0:
7         return []
8     for i in range(num_len-size+1):
9         test = 0
10        for j in range(size):
11            if num[i+j]>test:
12                test = num[i+j]
13        B.append(test)
14
15    return B
16
```

```
1 # 方法三：
2 queue, res, i = [], [], 0
3 while size>0 and i<len(num):
4     if len(queue)>0 and i-size+1 > queue[0]: #若最大值queue[0]位置过期则弹出
5         queue.pop(0)
6     while len(queue)>0 and num[queue[-1]]<num[i]: #每次弹出所有比num[i]的数字
7         queue.pop()
8     queue.append(i)
9     if i>=size-1:
10        res.append(num[queue[0]])
11    i += 1
12 return res
13
```

## 65. 矩阵中的路径

### 题目描述

请设计一个函数，用来判断在一个矩阵中是否存在一条包含某字符串所有字符的路径。路径可以从矩阵中的任意一个格子开始，每一步可以在矩阵中向左，向右，向上，向下移动一个格子。如果一条路径经过了矩阵中的某一个格子，则之后不能再次进入这个格子。例如 `a b c e s f c s a d e e` 这样的 $3 \times 4$  矩阵中包含一条字符串"bcced"的路径，但是矩阵中不包含"abcb"路径，因为字符串的第一个字符b占据了矩阵中的第一行第二个格子之后，路径不能再次进入该格子。

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     def hasPath(self, board, row, col, word):
4         self.col, self.row = col, row
5         board = [list(board[col * i:col * i + col]) for i in range(row)]
6         for i in range(row):
7             for j in range(col):
8                 if board[i][j] == word[0]:
9                     self.b = False
10                    self.search(board, word[1:], [(i, j)], i, j)
11                    if self.b:
12                        return True
13        return False
14
15     def search(self, board, word, dict, i, j):
16         if word == "":
17             self.b = True
18             return
19         if j != 0 and (i, j - 1) not in dict and board[i][j - 1] == word[0]:
20             self.search(board, word[1:], dict + [(i, j - 1)], i, j - 1)
21         if i != 0 and (i - 1, j) not in dict and board[i - 1][j] == word[0]:
22             self.search(board, word[1:], dict + [(i - 1, j)], i - 1, j)
23         if j != self.col - 1 and (i, j + 1) not in dict and board[i][j + 1] == word[0]:
24             self.search(board, word[1:], dict + [(i, j + 1)], i, j + 1)
25         if i != self.row - 1 and (i + 1, j) not in dict and board[i + 1][j] == word[0]:
26             self.search(board, word[1:], dict + [(i + 1, j)], i + 1, j)
27         ...
28
```

```
1 # 方法二：递归
2 class Solution:
3     def hasPath(self, matrix, rows, cols, path):
4         for i, s in enumerate(matrix):
5             if s==path[0] and self.visit([(i//cols, i%cols)], matrix, rows, cols, path):
6                 return True
7         return False
8
9     def visit(self, ans, matrix, rows, cols, path):
10        if len(ans)==len(path):
11            return True
12        i,j = ans[-1]
13        nex = [(ii,jj) for ii,jj in [(i,j-1),(i,j+1),(i-1,j),(i+1,j)] if 0<= ii <rows and 0<= jj <cols and
```

```
15     (ii,jj) not in ans and
16     matrix[ii*cols +jj]==path[len(ans)])
17 return sum([self.visit(ans+[x], matrix, rows, cols, path) for x in nex])
18 ...
19
20
```

## 66. 机器人的运动范围

### 题目描述

地上有一个m行和n列的方格。一个机器人从坐标0,0的格子开始移动，每一次只能向左，右，上，下四个方向移动一格，但是不能进入行坐标和列坐标的数位之和大于k的格子。例如，当k为18时，机器人能够进入方格(35,37)，因为 $3+5+3+7 = 18$ 。但是，它不能进入方格(35,38)，因为 $3+5+3+8 = 19$ 。请问该机器人能够达到多少个格子？

```
1 # -*- coding:utf-8 -*-
2 class Solution:
3     '''def movingCount(self, threshold, rows, cols):
4         # write code here
5         # 这个从大往小看是不是比较简单？
6         # 一道典型的动态规划题目，用DFS|BFS，把大问题分拆成小问题
7         len_row = len(str(rows))#是几位数
8         len_col = len(str(cols))#是几位数
9         ...
10 ...
11     将地图全部置1，遍历能够到达的点，将遍历的点置0并令计数+1.这个思路在找前后左右相连的点很有用，比如leetcode中的海岛个数问题/最大海岛问题都可以用这种方法来求解。
12 ...
13
14     def __init__(self):
15         self.count = 0
16
17     def movingCount(self, threshold, rows, cols):
18         # write code here
19         arr = [[1 for i in range(cols)] for j in range(rows)]
20         self.findway(arr, 0, 0, threshold)
21         return self.count
22
23     def findway(self, arr, i, j, k):
24         if i < 0 or j < 0 or i >= len(arr) or j >= len(arr[0]):
25             return
26         tmpi = list(map(int, list(str(i))))
27         tmpj = list(map(int, list(str(j))))
28         if sum(tmpi) + sum(tmpj) > k or arr[i][j] != 1:
29             return
30         arr[i][j] = 0
31         self.count += 1
32         self.findway(arr, i + 1, j, k)
33         self.findway(arr, i - 1, j, k)
34         self.findway(arr, i, j + 1, k)
35         self.findway(arr, i, j - 1, k)
36
37
```