

第一题

1) `find_name_value` 的主要功能是从一个数据目录名中提取变量名和变量值，并将它们作为一个元组（其中变量值为浮点型）返回，目录名的格式是 `<name><value>`，如果是负值则在变量值后会有 `n` 表示。

2) 编写测试函数如下，经过测试，函数功能实现如预期。

```
def test_find_name_value():
    test_cases = [
        # 正常输入（正浮点数）
        ("phi0.1"),
        # 正常输入（整数）
        ("xN14"),
        # 正常输入（负浮点数，后缀 'n'）
        ("kappa0.5n"),
        # 正常输入（负整数，后缀 'n'）
        ("yN30n"),
        # 边界输入（仅变量名，无数值）
        ("alpha"),
        # 边界输入（数值为零）
        ("beta0"),
        # 异常输入（数值格式不正确）
        ("g2ammaabn"),
        # 异常输入（带有额外字符但没有数值）
        ("zeta-xyz_"),
        # 边界输入（空字符串）
        (""),
        # 异常输入（只有数值）
        ("20.5n"),
    ]

    for i, input_data in enumerate(test_cases):
        result = find_name_value(input_data)
        print(result)
```

输出如下

```
('phi', 0.1)
('xN', 14.0)
('kappa', -0.5)
('yN', -30.0)
('alpha', None)
('beta', 0.0)
('g', 2.0)
('zeta-xyz_', None)
('', None)
('', -20.5)
```

3) 对于用下划线连接的文件名，原函数并不能正确解析，原函数仅能解析单个目录名，因此修改如下：

```
def find_name_value(folder_name):
    '''Split the name of a data directory into a list of (name, value) tuples.
```

The format of each segment in ``folder_name``:

<name><value>

If the value is negative, it should be followed by a 'n'.

Args:

folder_name (str): the name of a :term:`data directory`.

Returns:

list: A list of tuples, where each tuple contains:

- * name (str): variable name.
- * value (float): value of the variable.

...

分割输入字符串

segments = folder_name.split('_')

results = []

解析每个部分

pattern = '([-+]?\\d*\\.\\d+|([-+]?\\d+))'

for segment in segments:

rst = re.split(pattern, segment)

if len(rst) < 2:

results.append((segment, None))

continue

name = rst[0]

valuestr = rst[1]

sign_str = ''

if len(rst) > 2:

sign_str = rst[2]

if sign_str == 'n':

value = '-' + valuestr

else:

value = valuestr

results.append((name, float(value)))

return results

运行后得到结果

```
[('phi', 0.1), ('xN', 14.2), ('kappa', -0.5)]
[('a', 1.0), ('b', -14.0), ('n', 0.0), ('c', 0.2)]
```

第二题

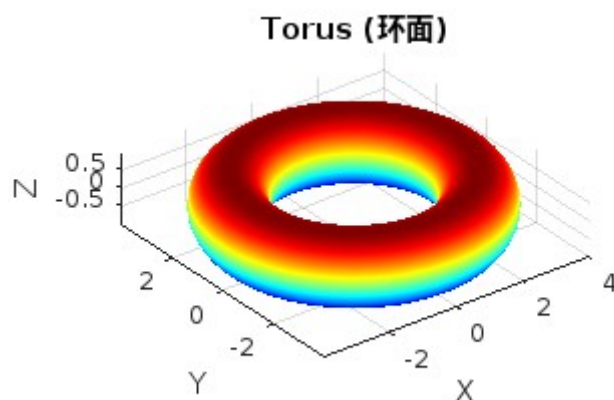
```
R = 3;
r = 1;
theta = linspace(0, 2*pi, 100);
phi = linspace(0, 2*pi, 100);
[Theta, Phi] = meshgrid(theta, phi);
```

```

X = (R + r * cos(Theta)) .* cos(Phi);
Y = (R + r * cos(Theta)) .* sin(Phi);
Z = r * sin(Theta);

figure;
surf(X, Y, Z);
shading interp;
colormap jet;
axis equal;
xlabel('X');
ylabel('Y');
zlabel('Z');
title('Torus (环面)');

```



第三题

```
Sum[1/(n^3 + n^2), {n, 1, Infinity}]
```

结果为 $-1 + \frac{\pi^2}{6}$

```
Integrate[Sqrt[x] Log[x]/(x + 1)^2, {x, 0, Infinity}]
```

结果为 π

第四题

Q : Find the solution of the following equation with respect to θ :

$$A \cos \theta + B \sin \theta + C = 0$$

A :

let $x_1 = \cos \theta$ and $x_2 = \sin \theta$, then the solution is given by the intersection of the circle and the line:

$$\begin{aligned} x_1^2 + x_2^2 &= 1 \\ Ax_1 + Bx_2 + C &= 0 \end{aligned}$$

We reformulate the equations in a parametric form:

$$|\mathbf{x}|^2 = 1$$

$$\mathbf{x}(t) = \mathbf{a} + t\mathbf{b}$$

where $\mathbf{x} = (x_1, x_2)$, $\mathbf{a} = (0, -C/B)$, $\mathbf{b} = (-C/A, C/B)$, and t is a parameter. The intersection points satisfy the following equation:

$$|\mathbf{a} + t\mathbf{b}|^2 = 1$$

which can be solved for t to find the intersection points:

$$t_{1,2} = \frac{-\mathbf{a} \cdot \mathbf{b} \pm \sqrt{(\mathbf{a} \cdot \mathbf{b})^2 - |\mathbf{b}|^2(|\mathbf{a}|^2 - 1)}}{|\mathbf{b}|^2}$$