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#exercise5.3
#15.11.11
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```
from exercise2 import *
import numpy as np
```

```
def _q3():
    A = np.matrix([[10,7, 8, 7],
                   [7, 5, 6, 5],
                   [8, 6, 10, 9],
                   [7, 5, 9, 10]])
    detA = np.linalg.det(A)
    print("detA:", detA)
    eig_val, eig_array = np.linalg.eig(A)
    print("eig_val:", eig_val)
    cond2A = np.linalg.cond(A, p = 2)
    print("cond2A:", cond2A)
    b = np.matrix([[32], [23], [33], [31]])
    x = np.linalg.solve(A, b)
    A_plus_delta_A = np.matrix([[10, 7, 8.1, 7.2],
                                 [7.08, 5.04, 6, 5],
                                 [8, 5.98, 9.89, 9],
                                 [6.99, 5, 9, 9.98]])
    delta_x = np.linalg.solve(A_plus_delta_A, b) - x
    print("delta_x:", delta_x)
    norm2_delta_x = np.linalg.norm(delta_x, 2)
    print("norm2_delta_x:", norm2_delta_x)
    relative_error_x = norm2_delta_x / np.linalg.norm(x,2)
    print("relative_error_x:", relative_error_x)
    delta_A = A_plus_delta_A - A
    relative_error_A = np.linalg.norm(delta_A, 2) / np.linalg.norm(A, 2)
    print("relative_error_A:", relative_error_A)
```

```
def main():
    _q3()
```

```
if __name__ == '__main__':
    main()
```

运算结果如下：

detA: 1.0

eig_val: [3.02886853e+01 3.85805746e+00 1.01500484e-02 8.43107150e-01]

cond2A: 2984.09270168

delta_x: [[-10.58625819]

[17.37408768]

[-4.22579146]

[2.52401097]]

norm2_delta_x: 20.9321697376

relative_error_x: 10.4660848688

relative_error_A: 0.00762028751845

[Finished in 1.0s]

对运算结果的分析：

由于这个方程的系数矩阵 A 的条件数 cond2A 为 2984，我们可以认为这个方程是病态的，所以当 relative_error_A，即 A 的扰动很小的时候，x 的解变化很大。