实验一 AES 密码算法

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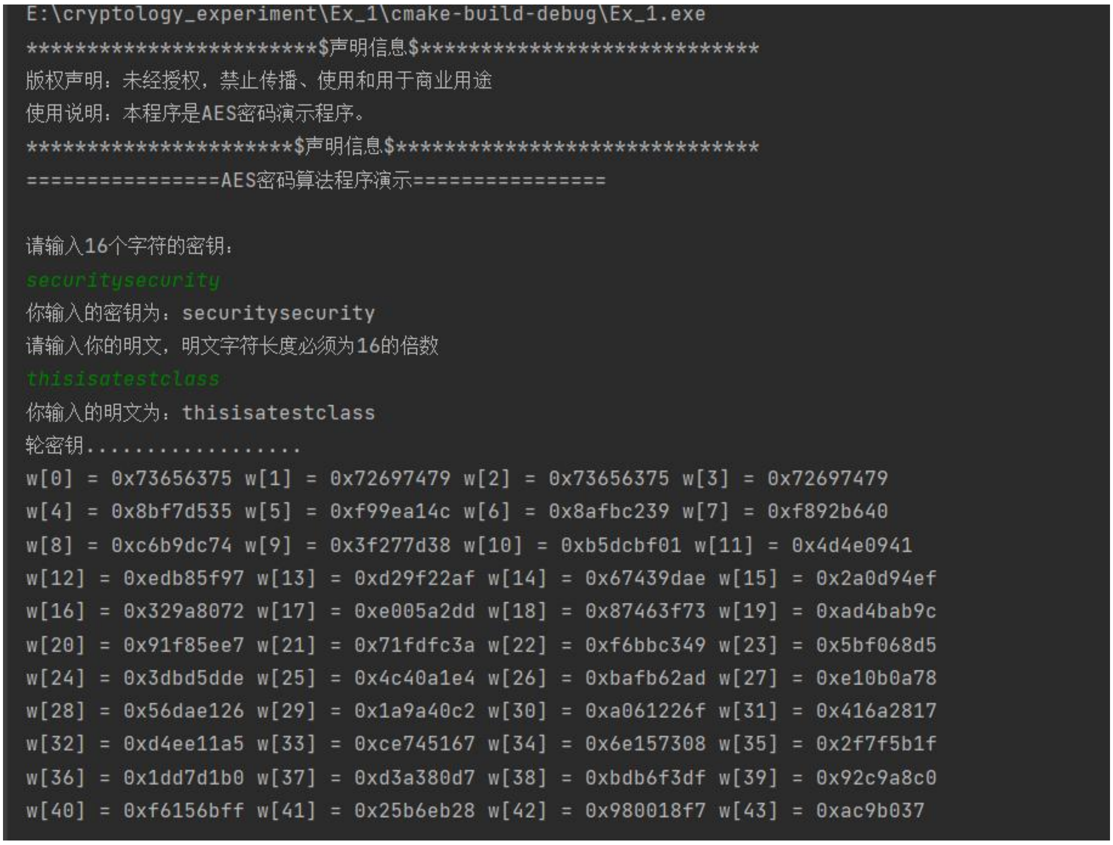
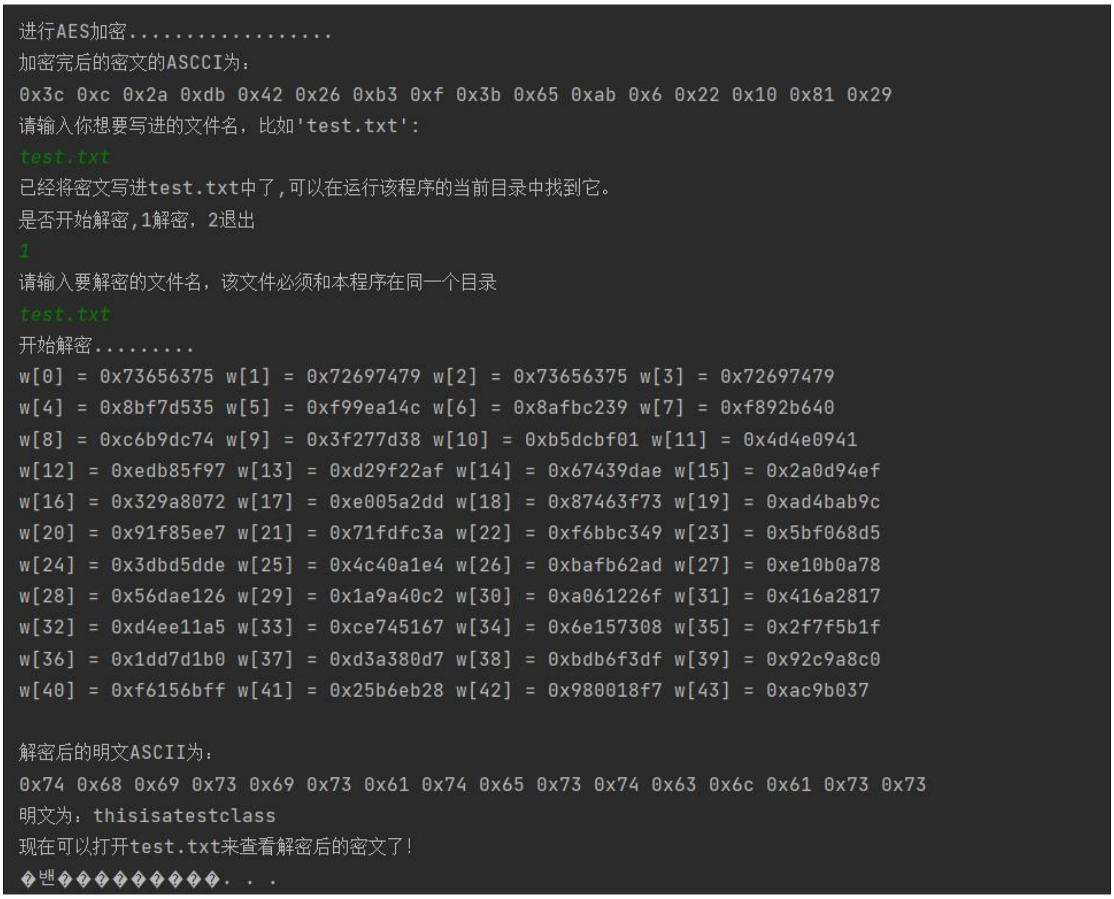
一、运行截图

1．明文为 thisisatestclass,密钥为 securitysecurity

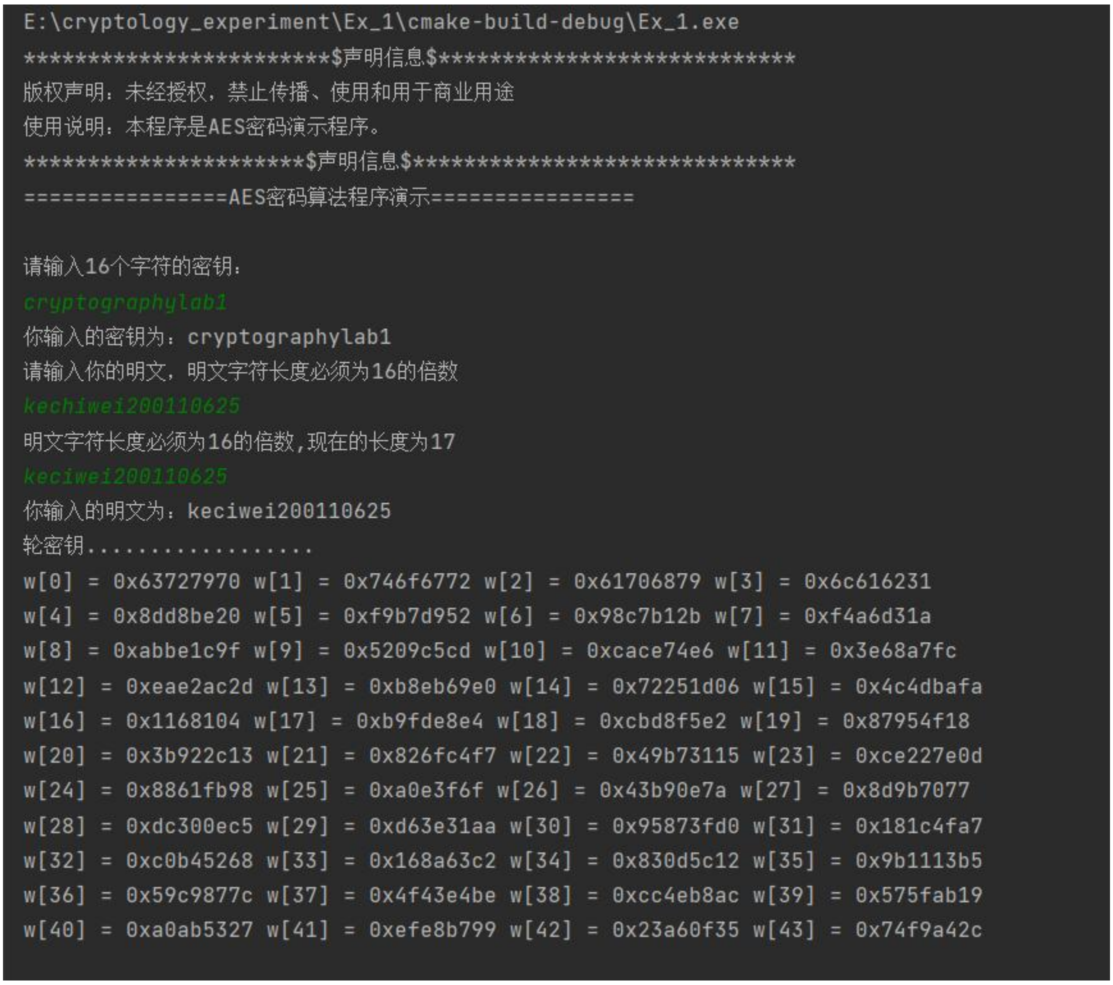


```
E:\cryptology_experiment\Ex_1\cmake-build-debug\Ex_1.exe
************************$声明信息$****************************
版权声明：未经授权，禁止传播、使用和用于商业用途
使用说明：本程序是AES密码演示程序。
**********************$声明信息$******************************
================AES密码算法程序演示================

请输入16个字符的密钥：
securitysecurity
你输入的密钥为：securitysecurity
请输入你的明文，明文字符长度必须为16的倍数
thisisatestclass
你输入的明文为：thisisatestclass
轮密钥..................
w[0] = 0x73656375 w[1] = 0x72697479 w[2] = 0x73656375 w[3] = 0x72697479
w[4] = 0x8bf7d535 w[5] = 0xf99ea14c w[6] = 0x8afbc239 w[7] = 0xf892b640
w[8] = 0xc6b9dc74 w[9] = 0x3f277d38 w[10] = 0xb5dcbf01 w[11] = 0x4d4e0941
w[12] = 0xedb85f97 w[13] = 0xd29f22af w[14] = 0x67439dae w[15] = 0x2a0d94ef
w[16] = 0x329a8072 w[17] = 0xe005a2dd w[18] = 0x87463f73 w[19] = 0xad4bab9c
w[20] = 0x91f85ee7 w[21] = 0x71fdfc3a w[22] = 0xf6bbc349 w[23] = 0x5bf068d5
w[24] = 0x3dbd5dde w[25] = 0x4c40a1e4 w[26] = 0xbafb62ad w[27] = 0xe10b0a78
w[28] = 0x56dae126 w[29] = 0x1a9a40c2 w[30] = 0xa061226f w[31] = 0x416a2817
w[32] = 0xd4ee11a5 w[33] = 0xce745167 w[34] = 0x6e157308 w[35] = 0x2f7f5b1f
w[36] = 0x1dd7d1b0 w[37] = 0xd3a380d7 w[38] = 0xbdb6f3df w[39] = 0x92c9a8c0
w[40] = 0xf6156bff w[41] = 0x25b6eb28 w[42] = 0x980018f7 w[43] = 0xac9b037
```



```
进行AES加密..................
加密完后的密文的ASCCI为：
0x3c 0xc 0x2a 0xdb 0x42 0x26 0xb3 0xf 0x3b 0x65 0xab 0x6 0x22 0x10 0x81 0x29
请输入你想要写进的文件名，比如'test.txt':
test.txt
已经将密文写进test.txt中了,可以在运行该程序的当前目录中找到它。
是否开始解密,1解密，2退出
1
请输入要解密的文件名，该文件必须和本程序在同一个目录
test.txt
开始解密.........
w[0] = 0x73656375 w[1] = 0x72697479 w[2] = 0x73656375 w[3] = 0x72697479
w[4] = 0x8bf7d535 w[5] = 0xf99ea14c w[6] = 0x8afbc239 w[7] = 0xf892b640
w[8] = 0xc6b9dc74 w[9] = 0x3f277d38 w[10] = 0xb5dcbf01 w[11] = 0x4d4e0941
w[12] = 0xedb85f97 w[13] = 0xd29f22af w[14] = 0x67439dae w[15] = 0x2a0d94ef
w[16] = 0x329a8072 w[17] = 0xe005a2dd w[18] = 0x87463f73 w[19] = 0xad4bab9c
w[20] = 0x91f85ee7 w[21] = 0x71fdfc3a w[22] = 0xf6bbc349 w[23] = 0x5bf068d5
w[24] = 0x3dbd5dde w[25] = 0x4c40a1e4 w[26] = 0xbafb62ad w[27] = 0xe10b0a78
w[28] = 0x56dae126 w[29] = 0x1a9a40c2 w[30] = 0xa061226f w[31] = 0x416a2817
w[32] = 0xd4ee11a5 w[33] = 0xce745167 w[34] = 0x6e157308 w[35] = 0x2f7f5b1f
w[36] = 0x1dd7d1b0 w[37] = 0xd3a380d7 w[38] = 0xbdb6f3df w[39] = 0x92c9a8c0
w[40] = 0xf6156bff w[41] = 0x25b6eb28 w[42] = 0x980018f7 w[43] = 0xac9b037

解密后的明文ASCII为：
0x74 0x68 0x69 0x73 0x69 0x73 0x61 0x74 0x65 0x73 0x74 0x63 0x6c 0x61 0x73 0x73
明文为：thisisatestclass
现在可以打开test.txt来查看解密后的密文了！
�밴���������. . .
```

2．明文：keciwei200110625，密钥：cryptographylab1



```
E:\cryptology_experiment\Ex_1\cmake-build-debug\Ex_1.exe
************************$声明信息$****************************
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使用说明：本程序是AES密码演示程序。
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================AES密码算法程序演示================

请输入16个字符的密钥：
cryptographylab1
你输入的密钥为：cryptographylab1
请输入你的明文，明文字符长度必须为16的倍数
kechiwei200110625
明文字符长度必须为16的倍数,现在的长度为17
keciwei200110625
你输入的明文为：keciwei200110625
轮密钥..................
w[0] = 0x63727970 w[1] = 0x746f6772 w[2] = 0x61706879 w[3] = 0x6c616231
w[4] = 0x8dd8be20 w[5] = 0xf9b7d952 w[6] = 0x98c7b12b w[7] = 0xf4a6d31a
w[8] = 0xabbe1c9f w[9] = 0x5209c5cd w[10] = 0xcace74e6 w[11] = 0x3e68a7fc
w[12] = 0xeae2ac2d w[13] = 0xb8eb69e0 w[14] = 0x72251d06 w[15] = 0x4c4dbafa
w[16] = 0x1168104 w[17] = 0xb9fde8e4 w[18] = 0xcbd8f5e2 w[19] = 0x87954f18
w[20] = 0x3b922c13 w[21] = 0x826fc4f7 w[22] = 0x49b73115 w[23] = 0xce227e0d
w[24] = 0x8861fb98 w[25] = 0xa0e3f6f w[26] = 0x43b90e7a w[27] = 0x8d9b7077
w[28] = 0xdc300ec5 w[29] = 0xd63e31aa w[30] = 0x95873fd0 w[31] = 0x181c4fa7
w[32] = 0xc0b45268 w[33] = 0x168a63c2 w[34] = 0x830d5c12 w[35] = 0x9b1113b5
w[36] = 0x59c9877c w[37] = 0x4f43e4be w[38] = 0xcc4eb8ac w[39] = 0x575fab19
w[40] = 0xa0ab5327 w[41] = 0xefe8b799 w[42] = 0x23a60f35 w[43] = 0x74f9a42c
```

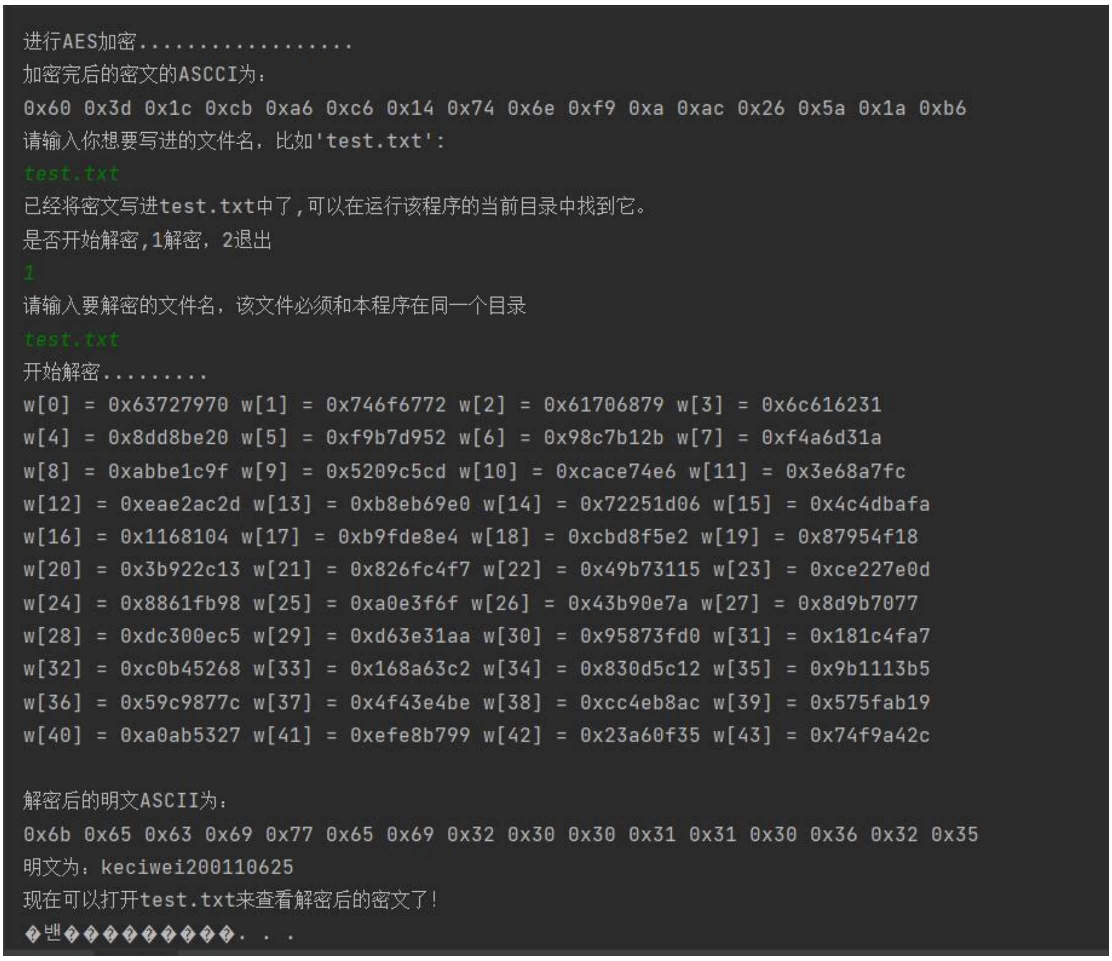

```
进行AES加密..................
加密完后的密文的ASCCI为：
0x60 0x3d 0x1c 0xcb 0xa6 0xc6 0x14 0x74 0x6e 0xf9 0xa 0xac 0x26 0x5a 0x1a 0xb6
请输入你想要写进的文件名，比如'test.txt'：
test.txt
已经将密文写进test.txt中了,可以在运行该程序的当前目录中找到它。
是否开始解密,1解密，2退出
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请输入要解密的文件名，该文件必须和本程序在同一个目录
test.txt
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w[0] = 0x63727970 w[1] = 0x746f6772 w[2] = 0x61706879 w[3] = 0x6c616231
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w[20] = 0x3b922c13 w[21] = 0x826fc4f7 w[22] = 0x49b73115 w[23] = 0xce227e0d
w[24] = 0x8861fb98 w[25] = 0xa0e3f6f w[26] = 0x43b90e7a w[27] = 0x8d9b7077
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w[40] = 0xa0ab5327 w[41] = 0xefe8b799 w[42] = 0x23a60f35 w[43] = 0x74f9a42c

解密后的明文ASCII为：
0x6b 0x65 0x63 0x69 0x77 0x65 0x69 0x32 0x30 0x30 0x31 0x31 0x30 0x36 0x32 0x35
明文为：keciwei200110625
现在可以打开test.txt来查看解密后的密文了！
�밴����������. . .
```
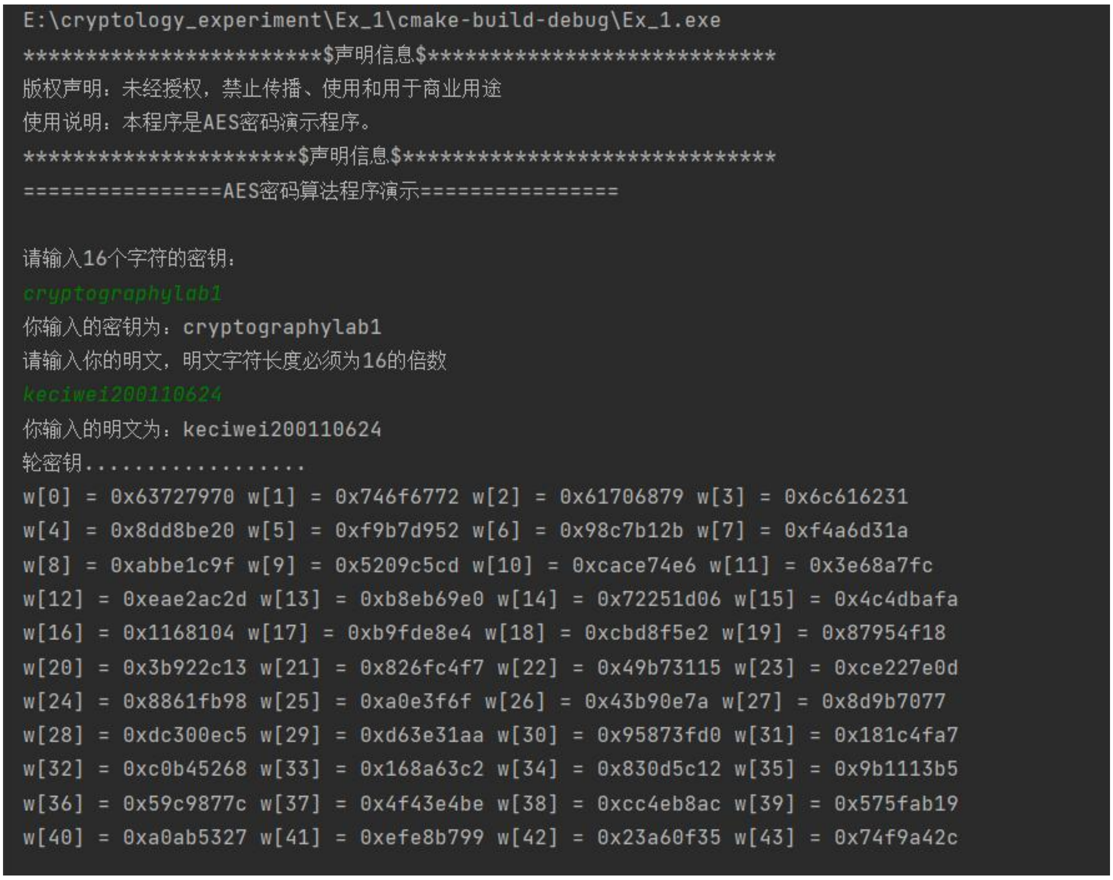

3．明文：keciwei200110624，密钥：cryptographylab1



```
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请输入16个字符的密钥：
cryptographylab1
你输入的密钥为：cryptographylab1
请输入你的明文，明文字符长度必须为16的倍数
keciwei200110624
你输入的明文为：keciwei200110624
轮密钥..................
w[0] = 0x63727970 w[1] = 0x746f6772 w[2] = 0x61706879 w[3] = 0x6c616231
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w[12] = 0xeae2ac2d w[13] = 0xb8eb69e0 w[14] = 0x72251d06 w[15] = 0x4c4dbafa
w[16] = 0x1168104 w[17] = 0xb9fde8e4 w[18] = 0xcbd8f5e2 w[19] = 0x87954f18
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w[32] = 0xc0b45268 w[33] = 0x168a63c2 w[34] = 0x830d5c12 w[35] = 0x9b1113b5
w[36] = 0x59c9877c w[37] = 0x4f43e4be w[38] = 0xcc4eb8ac w[39] = 0x575fab19
w[40] = 0xa0ab5327 w[41] = 0xefe8b799 w[42] = 0x23a60f35 w[43] = 0x74f9a42c
```

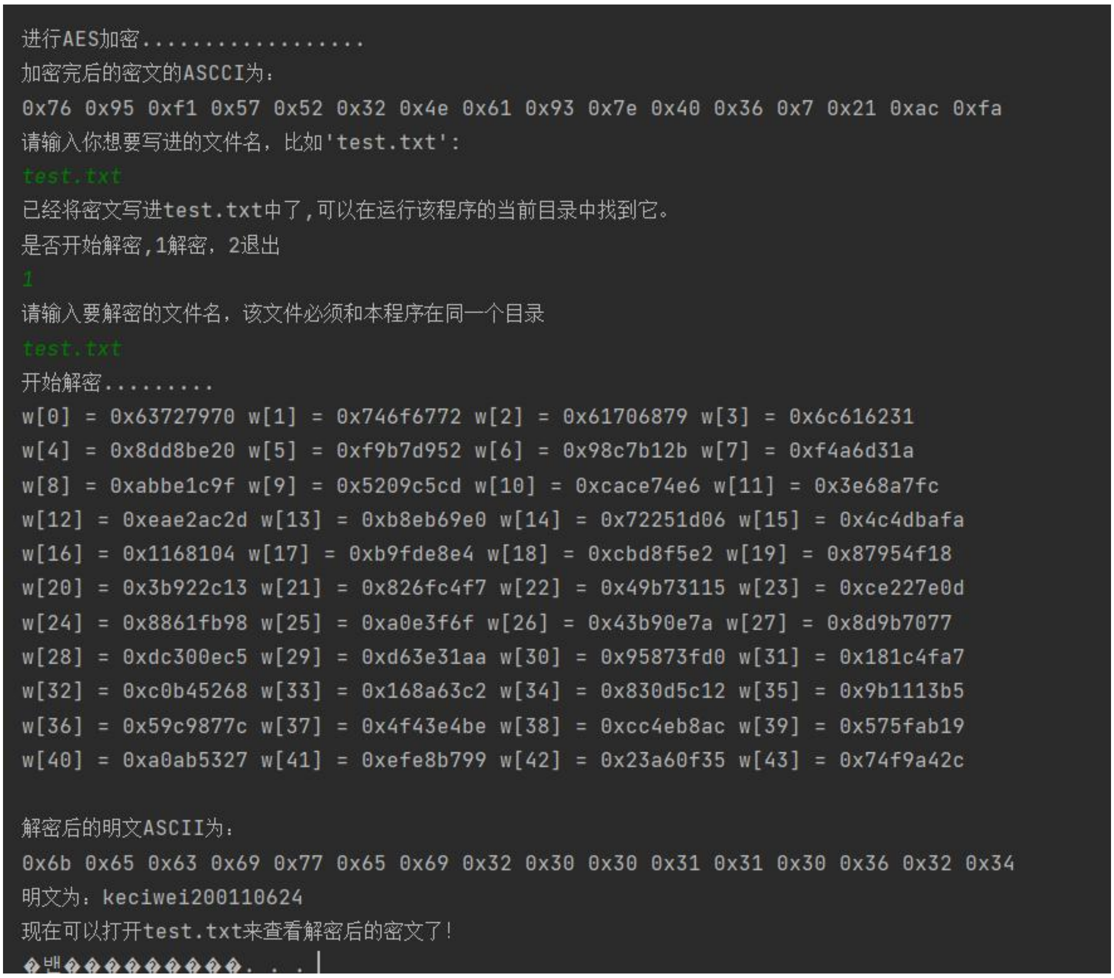

```
进行AES加密..................
加密完后的密文的ASCCI为：
0x76 0x95 0xf1 0x57 0x52 0x32 0x4e 0x61 0x93 0x7e 0x40 0x36 0x7 0x21 0xac 0xfa
请输入你想要写进的文件名，比如'test.txt':
test.txt
已经将密文写进test.txt中了,可以在运行该程序的当前目录中找到它。
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w[16] = 0x1168104 w[17] = 0xb9fde8e4 w[18] = 0xcbd8f5e2 w[19] = 0x87954f18
w[20] = 0x3b922c13 w[21] = 0x826fc4f7 w[22] = 0x49b73115 w[23] = 0xce227e0d
w[24] = 0x8861fb98 w[25] = 0xa0e3f6f w[26] = 0x43b90e7a w[27] = 0x8d9b7077
w[28] = 0xdc300ec5 w[29] = 0xd63e31aa w[30] = 0x95873fd0 w[31] = 0x181c4fa7
w[32] = 0xc0b45268 w[33] = 0x168a63c2 w[34] = 0x830d5c12 w[35] = 0x9b1113b5
w[36] = 0x59c9877c w[37] = 0x4f43e4be w[38] = 0xcc4eb8ac w[39] = 0x575fab19
w[40] = 0xa0ab5327 w[41] = 0xefe8b799 w[42] = 0x23a60f35 w[43] = 0x74f9a42c

解密后的明文ASCII为：
0x6b 0x65 0x63 0x69 0x77 0x65 0x69 0x32 0x30 0x30 0x31 0x31 0x30 0x36 0x32 0x34
明文为：keciwei200110624
现在可以打开test.txt来查看解密后的密文了!
�밴���������. . . |
```

二、实验过程中遇到的问题有哪些？你是怎么解决的。

1. 在列混淆函数中，需要实现 4*4 的矩阵乘法，而在做实验时总是发现结果不正确。
   (1) 解决措施：通过回看课件发现 AES 算法是在 GF（2）域中进行，而在这个域中的加法为异或操作。将代码中的加法改为异或则结果正确
2. 在轮密钥加函数中，出现两个问题：
   (1) 问题一同上：加法未改成异或（解决措施：将加法改成异或即可）
   (2) 问题二：array 矩阵在读入时结构为按列存储，而在代码中我一开始习惯性的按行读取，因此总是结果对不上（解决措施：通过进一步阅读源码从而发现 bug 所在）