RSA1

Công cụ cần thiết:

- RsaCtfTool: công cụ phá mã RSA khi có weak publickey
  - Link: https://github.com/Ganapati/RsaCtfTool
- Python3

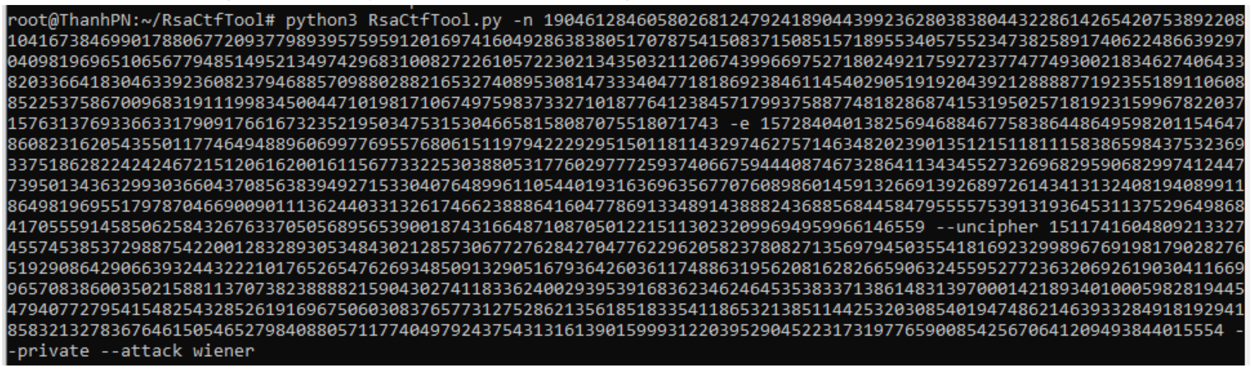
Cú pháp khi dùng RsaCtfTool:

python3 RsaCtfTool.py -n <n> -e <e> --uncipher <c> [--private] [--attack <type>]

Với :

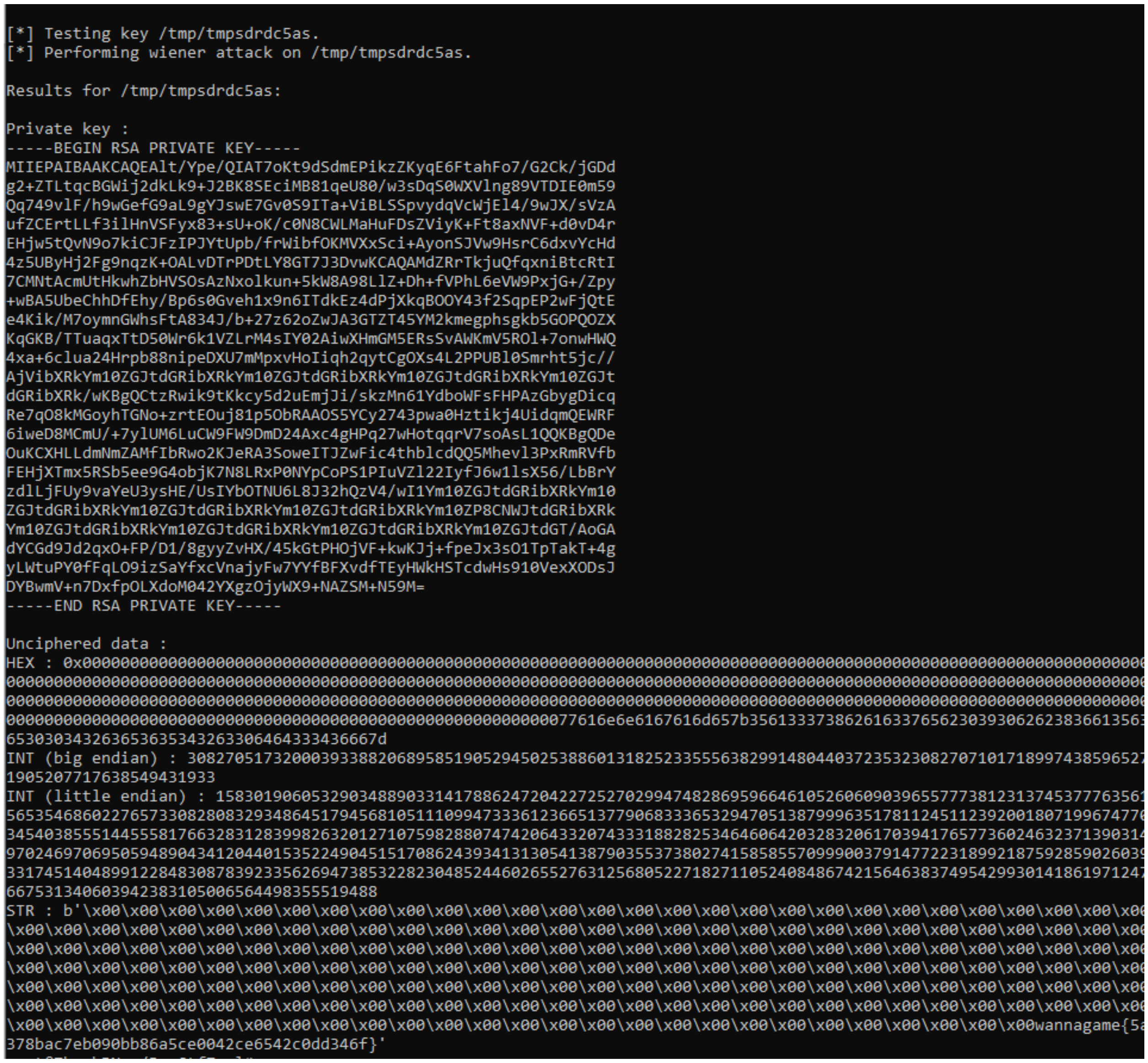
- <n> là modulus
- <e> là số mũ công khai
- <c> là văn bản bị mã hóa
- [--private] là tham số để yêu cầu hiện privatekey nếu giải được
- <type> là chỉ định attack khi biết được phương pháp crack

Khi mở file challenge ra, ta thấy có n,e1,c1. Thử dùng tool nào:



```
root@ThanhPN:~/RsaCtfTool# python3 RsaCtfTool.py -n 19046128460580268124792418904439923628038380443228614265420753892208
104167384699017880677209377989395759591201697416049286383805170787541508371508515718955340575523473825891740622486639297
040981969651065677948514952134974296831008272261057223021343503211206743996697527180249217592723774774930021834627406433
820336641830463392360823794688570988028821653274089530814733340477181869238461145402905191920439212888877192355189110608
852253758670096831911199834500447101981710674975983733271018776412384571799375887748182868741531950257181923159967822037
157631376933663317909176616732352195034753153046658158087075518071743 -e 15728404013825694688467758386448649598201154647
860823162054355011774649488960699776955768061511979422292951501181143297462757146348202390135121511811158386598437532369
337518628224242467215120616200161156773322530388053177602977725937406675944408746732864113434552732696829590682997412447
739501343632993036604370856383949271533040764899611054401931636963567707608986014591326691392689726143413132408194089911
864981969551797870466900901113624403313261746623888641604778691334891438882436885684458479555575391319364531137529649868
41705559145850625843267633705056895653900187431664871087050122151130232099694959966146559 --uncipher 1511741604809213327
455745385372988754220012832893053484302128573067727628427047762296205823780827135697945035541816923299896769198179028276
519290864290663932443222101765265476269348509132905167936426036117488631956208162826659063245595277236320692619030411669
965708386003502158811370738238888215904302741183362400293953916836234624645353833713861483139700014218934010005982819445
479407727954154825432852619169675060308376577312752862135618518335411865321385114425320308540194748621463933284918192941
8583213278367646150546527984088057117740497924375431316139015999312203952904522317319776590085425670641209493844015554 -
-private --attack wiener
```

Và đây là kết quả



```
[*] Testing key /tmp/tmpsdrdc5as.
[*] Performing wiener attack on /tmp/tmpsdrdc5as.

Results for /tmp/tmpsdrdc5as:

Private key :
-----BEGIN RSA PRIVATE KEY-----
MIIEPAIBAAKCAQEAlt/Ype/QIAT7oKt9dSdmEPikzZKyqE6FtahFo7/G2Ck/jGDd
g2+ZTLtqcBGWij2dkLk9+J2BK8SEciMB81qeU80/w3sDqS0WXVlng89VTDIE0m59
Qq749vlF/h9wGefG9aL9gYJswE7Gv0S9ITa+ViBLSSpvydqVcWjEl4/9wJX/sVzA
ufZCErtLLf3ilHnVSFyx83+sU+oK/c0N8CWLMaHuFDsZViyK+Ft8axNVF+d0vD4r
EHjw5tQvN9o7kiCJFzIPJYtUpb/frWibfOKMVXxSci+AyonSJVw9HsrC6dxvYcHd
4z5UByHj2Fg9nqzK+OALvDTrPDtLY8GT7J3DvwKCAQAMdZRrTkjuQfqxniBtcRtI
7CMNtAcmUtHkwhZbHVSOsAzNxolkun+5kW8A98LlZ+Dh+fVPhL6eVW9PxjG+/Zpy
+wBA5UbeChhDfEhy/Bp6s0Gveh1x9n6ITdkEz4dPjXkqBOOY43f2SqpEP2wFjQtE
e4Kik/M7oymnGWhsFtA834J/b+27z62oZwJA3GTZT45YM2kmegphsgkb5GOPQOZX
KqGKB/TTuaqxTtD50Wr6k1VZLrM4sIY02AiwXHmGM5ERsSvAWKmV5ROl+7onwHWQ
4xa+6clua24Hrpb88nipeDXU7mMpxvHoIiqh2qytCgOXs4L2PPUBl0Smrht5jc//
AjVibXRkYm10ZGJtdGRibXRkYm10ZGJtdGRibXRkYm10ZGJtdGRibXRkYm10ZGJt
dGRibXRk/wKBgQCtzRwik9tKkcy5d2uEmjJi/skzMn61YdboWFsFHPAzGbygDicq
Re7qO8kMGoyhTGNo+zrtEOuj81p5ObRAAOS5YCy2743pwa0Hztikj4UidqmQEWRF
6iweD8MCmU/+7ylUM6LuCW9FW9DmD24Axc4gHPq27wHotqqrV7soAsL1QQKBgQDe
OuKCXHLLdmNmZAMfIbRwo2KJeRA3SoweITJZwFic4thblcdQQ5Mhevl3PxRmRVfb
FEHjXTmx5RSb5ee9G4objK7N8LRxP0NYpCoPS1PIuVZl22IyfJ6w1lsX56/LbBrY
zdlLjFUy9vaYeU3ysHE/UsIYbOTNU6L8J32hQzV4/wI1Ym10ZGJtdGRibXRkYm10
ZGJtdGRibXRkYm10ZGJtdGRibXRkYm10ZP8CNWJtdGRibXRk
Ym10ZGJtdGRibXRkYm10ZGJtdGRibXRkYm10ZGJtdGT/AoGA
dYCGd9Jd2qxO+FP/D1/8gyyZvHX/45kGtPHOjVF+kwKJj+fpeJx3sO1TpTakT+4g
yLWtuPY0fFqLO9izSaYfxcVnajyFw7YYfBFXvdfTEyHWkHSTcdwHs910VexXODsJ
DYBwmV+n7DxfpOLXdoM042YXgzOjyWX9+NAZSM+N59M=
-----END RSA PRIVATE KEY-----

Unciphered data :
HEX : 0x0000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000077616e6e6167616d657b356133373862616337656230393062623836613563
653030343263653635343263306464333436667d
INT (big endian) : 30827051732000393388206895851905294502538860131825233555638299148044037235323082707101718997438596527
1905207717638549431933
INT (little endian) : 158301906053290348890331417886247204227252702994748286959664610526060903965577738123137453777635616
565354686022765733082808329348645179456810511109947333612366513779068333653294705138799963517811245112392001807199674776
345403855514455581766328312839982632012710759828807474206433207433318828253464606420328320617039417657736024632371390314
970246970695059489043412044015352249045151708624393413130541387903553738027415858557099900379147722318992187592859026039
331745140489912284830878392335626947385322823048524460265527631256805227182711052408486742156463837495429930141861971247
66753134060394238310500656449835519488
STR : b'\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00
\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00
\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00
\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00
\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00
\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00
\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00wannagame{5a
378bac7eb090bb86a5ce0042ce6542c0dd346f}'
```

Vậy là có flag rồi hihi, và nó xuất luôn cho mình private key nè. Lưu privatekey lại backup luôn.

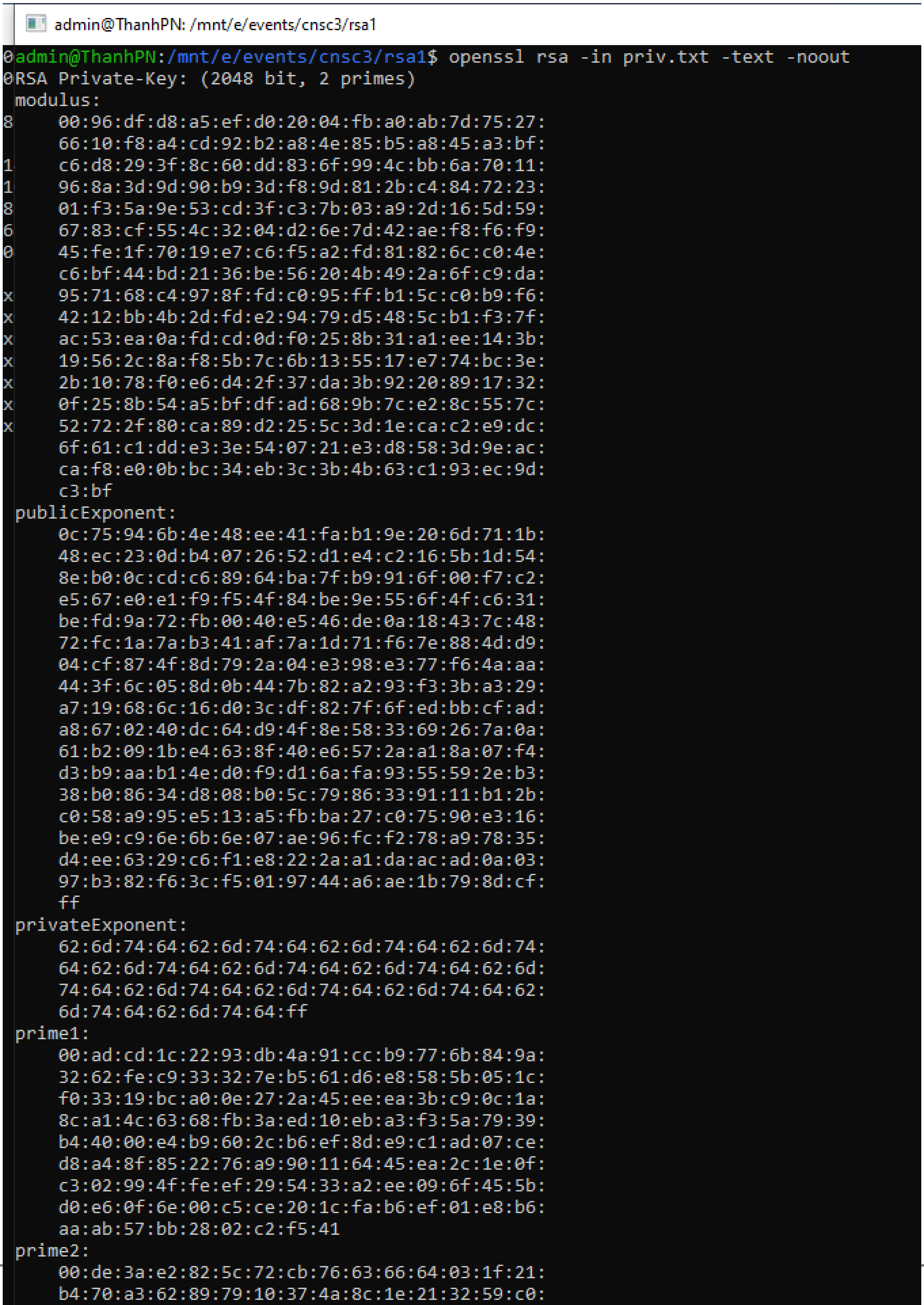
RSA2

Khi mở file challenge ra, đập vào mắt mình chính là… Challenge này dùng lại n của bài RSA1.

Đầu tiên mình sẽ trích thông tin từ private key ra p với q để có thể giải mã bài này

```
openssl rsa -in priv.txt -text -noout
```

với priv.txt là tên file privatekey của bài RSA1.



admin@ThanhPN: /mnt/e/events/cnsc3/rsa1

```
0admin@ThanhPN:/mnt/e/events/cnsc3/rsa1$ openssl rsa -in priv.txt -text -noout
0RSA Private-Key: (2048 bit, 2 primes)
 modulus:
8    00:96:df:d8:a5:ef:d0:20:04:fb:a0:ab:7d:75:27:
     66:10:f8:a4:cd:92:b2:a8:4e:85:b5:a8:45:a3:bf:
1    c6:d8:29:3f:8c:60:dd:83:6f:99:4c:bb:6a:70:11:
1    96:8a:3d:9d:90:b9:3d:f8:9d:81:2b:c4:84:72:23:
8    01:f3:5a:9e:53:cd:3f:c3:7b:03:a9:2d:16:5d:59:
6    67:83:cf:55:4c:32:04:d2:6e:7d:42:ae:f8:f6:f9:
0    45:fe:1f:70:19:e7:c6:f5:a2:fd:81:82:6c:c0:4e:
     c6:bf:44:bd:21:36:be:56:20:4b:49:2a:6f:c9:da:
x    95:71:68:c4:97:8f:fd:c0:95:ff:b1:5c:c0:b9:f6:
x    42:12:bb:4b:2d:fd:e2:94:79:d5:48:5c:b1:f3:7f:
x    ac:53:ea:0a:fd:cd:0d:f0:25:8b:31:a1:ee:14:3b:
x    19:56:2c:8a:f8:5b:7c:6b:13:55:17:e7:74:bc:3e:
x    2b:10:78:f0:e6:d4:2f:37:da:3b:92:20:89:17:32:
x    0f:25:8b:54:a5:bf:df:ad:68:9b:7c:e2:8c:55:7c:
x    52:72:2f:80:ca:89:d2:25:5c:3d:1e:ca:c2:e9:dc:
     6f:61:c1:dd:e3:3e:54:07:21:e3:d8:58:3d:9e:ac:
     ca:f8:e0:0b:bc:34:eb:3c:3b:4b:63:c1:93:ec:9d:
     c3:bf
 publicExponent:
     0c:75:94:6b:4e:48:ee:41:fa:b1:9e:20:6d:71:1b:
     48:ec:23:0d:b4:07:26:52:d1:e4:c2:16:5b:1d:54:
     8e:b0:0c:cd:c6:89:64:ba:7f:b9:91:6f:00:f7:c2:
     e5:67:e0:e1:f9:f5:4f:84:be:9e:55:6f:4f:c6:31:
     be:fd:9a:72:fb:00:40:e5:46:de:0a:18:43:7c:48:
     72:fc:1a:7a:b3:41:af:7a:1d:71:f6:7e:88:4d:d9:
     04:cf:87:4f:8d:79:2a:04:e3:98:e3:77:f6:4a:aa:
     44:3f:6c:05:8d:0b:44:7b:82:a2:93:f3:3b:a3:29:
     a7:19:68:6c:16:d0:3c:df:82:7f:6f:ed:bb:cf:ad:
     a8:67:02:40:dc:64:d9:4f:8e:58:33:69:26:7a:0a:
     61:b2:09:1b:e4:63:8f:40:e6:57:2a:a1:8a:07:f4:
     d3:b9:aa:b1:4e:d0:f9:d1:6a:fa:93:55:59:2e:b3:
     38:b0:86:34:d8:08:b0:5c:79:86:33:91:11:b1:2b:
     c0:58:a9:95:e5:13:a5:fb:ba:27:c0:75:90:e3:16:
     be:e9:c9:6e:6b:6e:07:ae:96:fc:f2:78:a9:78:35:
     d4:ee:63:29:c6:f1:e8:22:2a:a1:da:ac:ad:0a:03:
     97:b3:82:f6:3c:f5:01:97:44:a6:ae:1b:79:8d:cf:
     ff
 privateExponent:
     62:6d:74:64:62:6d:74:64:62:6d:74:64:62:6d:74:
     64:62:6d:74:64:62:6d:74:64:62:6d:74:64:62:6d:
     74:64:62:6d:74:64:62:6d:74:64:62:6d:74:64:62:
     6d:74:64:62:6d:74:64:ff
 prime1:
     00:ad:cd:1c:22:93:db:4a:91:cc:b9:77:6b:84:9a:
     32:62:fe:c9:33:32:7e:b5:61:d6:e8:58:5b:05:1c:
     f0:33:19:bc:a0:0e:27:2a:45:ee:ea:3b:c9:0c:1a:
     8c:a1:4c:63:68:fb:3a:ed:10:eb:a3:f3:5a:79:39:
     b4:40:00:e4:b9:60:2c:b6:ef:8d:e9:c1:ad:07:ce:
     d8:a4:8f:85:22:76:a9:90:11:64:45:ea:2c:1e:0f:
     c3:02:99:4f:fe:ef:29:54:33:a2:ee:09:6f:45:5b:
     d0:e6:0f:6e:00:c5:ce:20:1c:fa:b6:ef:01:e8:b6:
     aa:ab:57:bb:28:02:c2:f5:41
 prime2:
     00:de:3a:e2:82:5c:72:cb:76:63:66:64:03:1f:21:
     b4:70:a3:62:89:79:10:37:4a:8c:1e:21:32:59:c0:
```

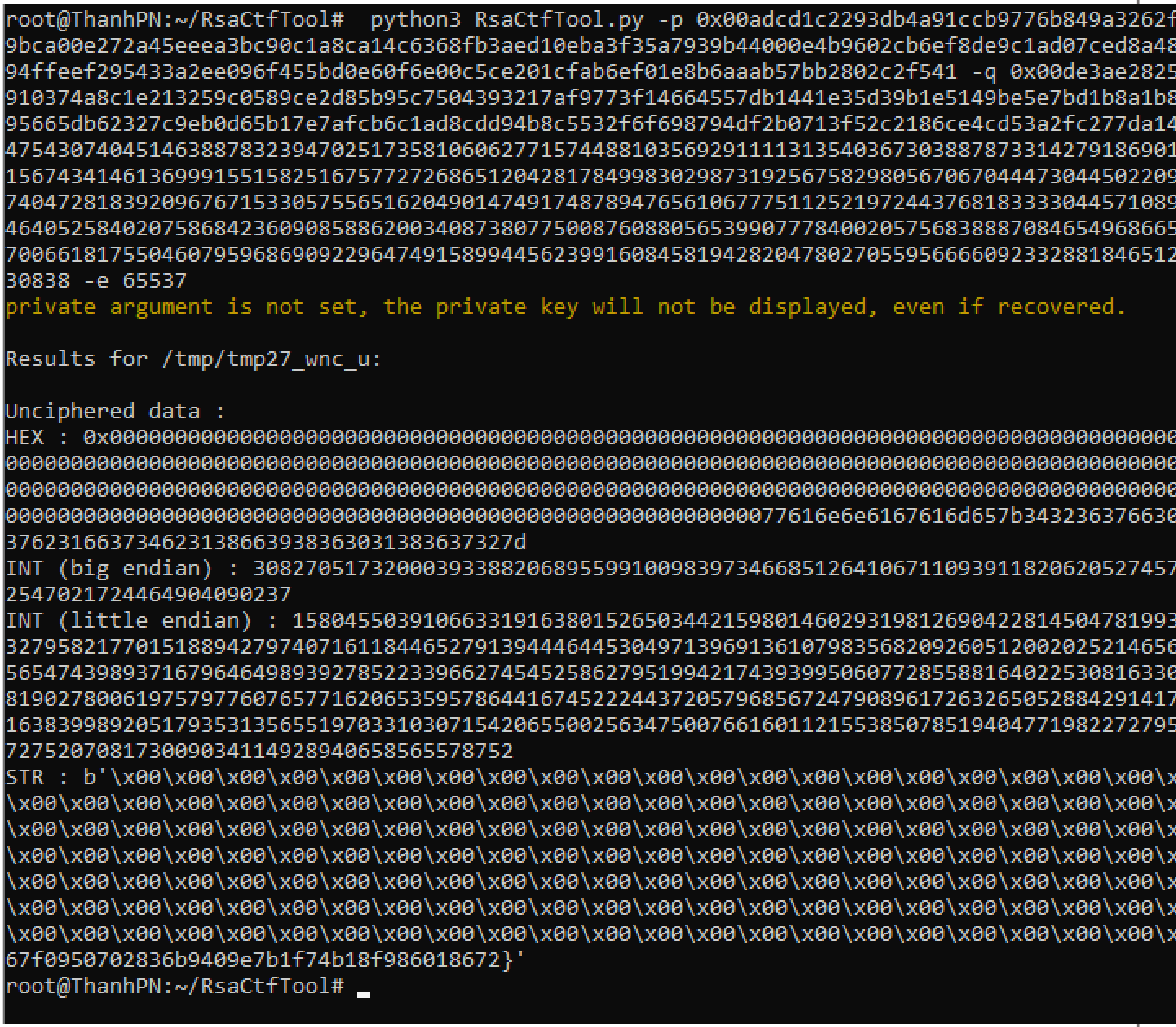
Với p và q là prime1 và prime2, ta đã có đủ dữ kiện để giải bài này

Cú pháp:

python3 RsaCtfTool.py -p <p> -q <q> -e <e> --uncipher <c>

Với p,q là prime1 và prime2 (sau khi bỏ dấu :)

Vì n = p*q, khi ta đã truyền p và q thì không cần n nữa

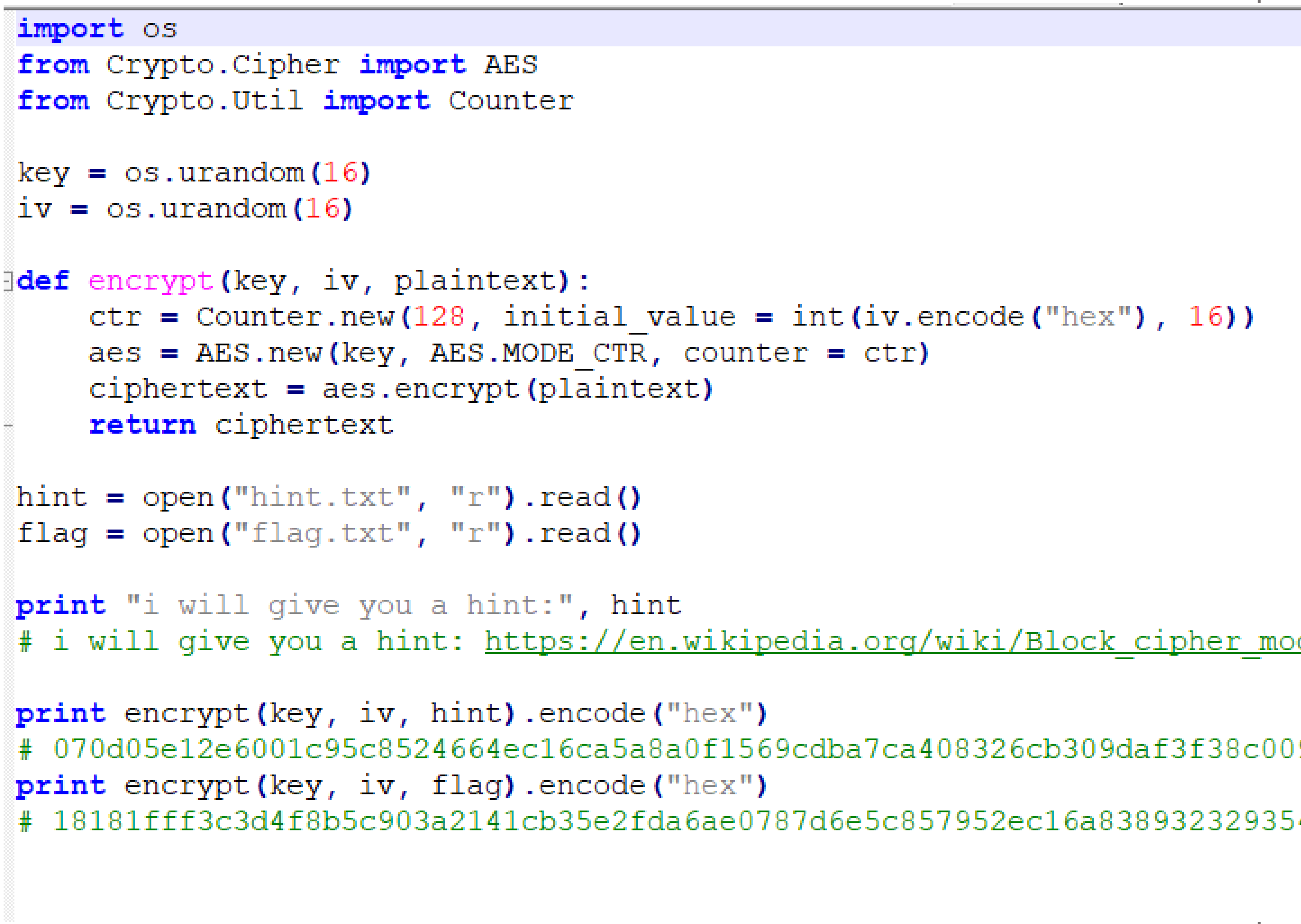


```
root@ThanhPN:~/RsaCtfTool#  python3 RsaCtfTool.py -p 0x00adcd1c2293db4a91ccb9776b849a3262f
9bca00e272a45eeea3bc90c1a8ca14c6368fb3aed10eba3f35a7939b44000e4b9602cb6ef8de9c1ad07ced8a48
94ffeef295433a2ee096f455bd0e60f6e00c5ce201cfab6ef01e8b6aaab57bb2802c2f541 -q 0x00de3ae2825
910374a8c1e213259c0589ce2d85b95c7504393217af9773f14664557db1441e35d39b1e5149be5e7bd1b8a1b8
95665db62327c9eb0d65b17e7afcb6c1ad8cdd94b8c5532f6f698794df2b0713f52c2186ce4cd53a2fc277da14
47543074045146388783239470251735810606277157448810356929111313540367303887873314279186901
156743414613699915515825167577272686512042817849983029873192567582980567067044473044502209
740472818392096767153305755651620490147491748789476561067775112521972443768183333044571089
464052584020758684236090858862003408738077500876088056539907778400205756838887084654968665
700661817550460795968690922964749158994456239916084581942820478027055956666092332881846512
30838 -e 65537
private argument is not set, the private key will not be displayed, even if recovered.

Results for /tmp/tmp27_wnc_u:

Unciphered data :
HEX : 0x0000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
000000000000000000000000000000000000000000000000000000000000000000000000000000000000000000
00000000000000000000000000000000000000000000000000000000077616e6e6167616d657b3432363766630
376231663734623138663938363031383637327d
INT (big endian) : 30827051732000393388206895599100983973466851264106711093911820620527457
2547021724464904090237
INT (little endian) : 158045503910663319163801526503442159801460293198126904228145047819993
327958217701518894279740716118446527913944464453049713969136107983568209260512002025214656
565474398937167964649893927852233966274545258627951994217439399506077285588164022530816330
819027800619757977607657716206535957864416745222443720579685672479089617263265052884291417
163839989205179353135655197033103071542065500256347500766160112155385078519404771982272795
727520708173009034114928940658565578752
STR : b'\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x
\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x
\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x
\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x
\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x
\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x
\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x00\x
67f0950702836b9409e7b1f74b18f986018672}'
root@ThanhPN:~/RsaCtfTool# _
```

Vậy là ra.

AES

Ở challenge này, thuật toán mã hóa là AES-CTR , là thuật toán mã hóa stream.



```
import os
from Crypto.Cipher import AES
from Crypto.Util import Counter

key = os.urandom(16)
iv = os.urandom(16)

def encrypt(key, iv, plaintext):
    ctr = Counter.new(128, initial_value = int(iv.encode("hex"), 16))
    aes = AES.new(key, AES.MODE_CTR, counter = ctr)
    ciphertext = aes.encrypt(plaintext)
    return ciphertext

hint = open("hint.txt", "r").read()
flag = open("flag.txt", "r").read()

print "i will give you a hint:", hint
# i will give you a hint: https://en.wikipedia.org/wiki/Block_cipher_mo

print encrypt(key, iv, hint).encode("hex")
# 070d05e12e6001c95c8524664ec16ca5a8a0f1569cdba7ca408326cb309daf3f38c00
print encrypt(key, iv, flag).encode("hex")
# 18181fff3c3d4f8b5c903a2141cb35e2fda6ae0787d6e5c857952ec16a83893232935
```

Ở challenge này BTC đã gợi ý vào wiki đọc thêm, và có 1 đoạn làm mình chú ý:

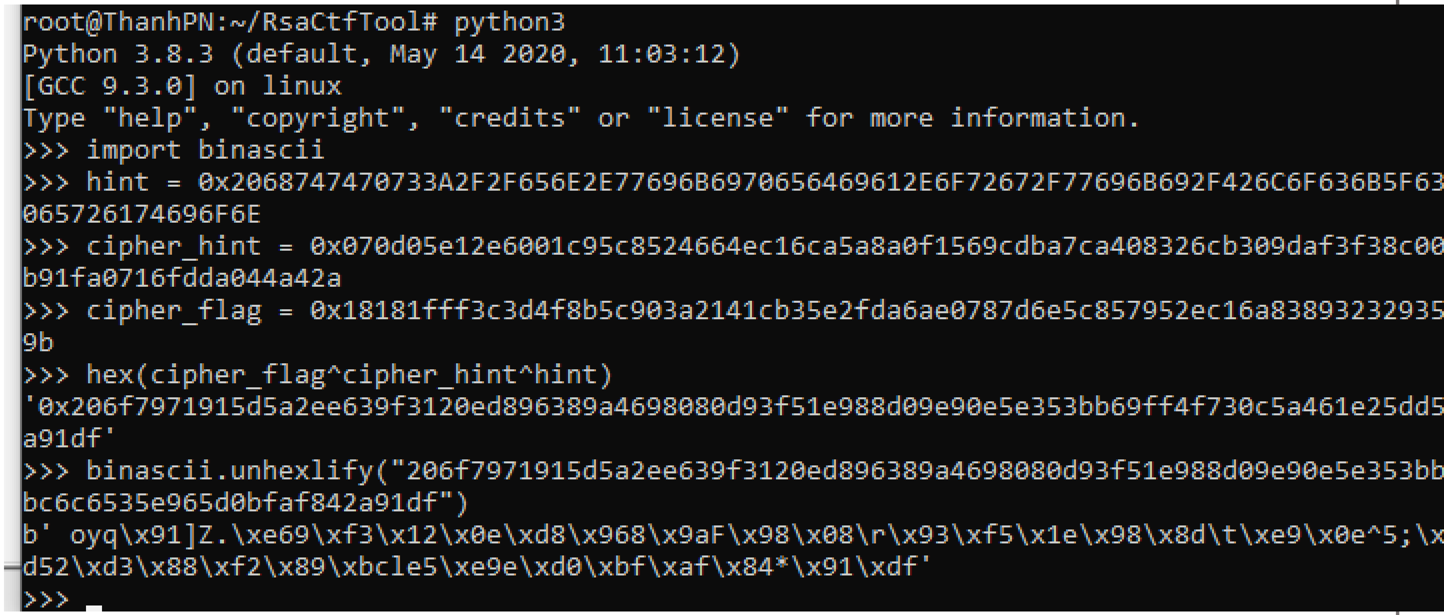
> If the IV/nonce is random, then they can be combined together with the counter using any invertible operation (concatenation, addition, or XOR) to produce the actual unique counter block for encryption. In case of a non-random nonce (such as a packet counter), the nonce and counter should be concatenated (e.g., storing the nonce in the upper 64 bits and the counter in the lower 64 bits of a 128-bit counter block). Simply adding or XORing the nonce and counter into a single value would break the security under a chosen-plaintext attack in many cases, since the attacker may be able to manipulate the entire IV–counter pair to cause a collision. Once an attacker controls the IV–counter

> pair and plaintext, XOR of the ciphertext with the known plaintext would yield a value that, when XORed with the ciphertext of the other block sharing the same IV–counter pair, would decrypt that block.[24]

Về cơ bản, vì key và VI không bị thay đổi khi tạo 2 ciphertext khác nhau, chỉ cần XOR ba cái cipher_hint, cipher_flag và hint là có thể lấy được flag

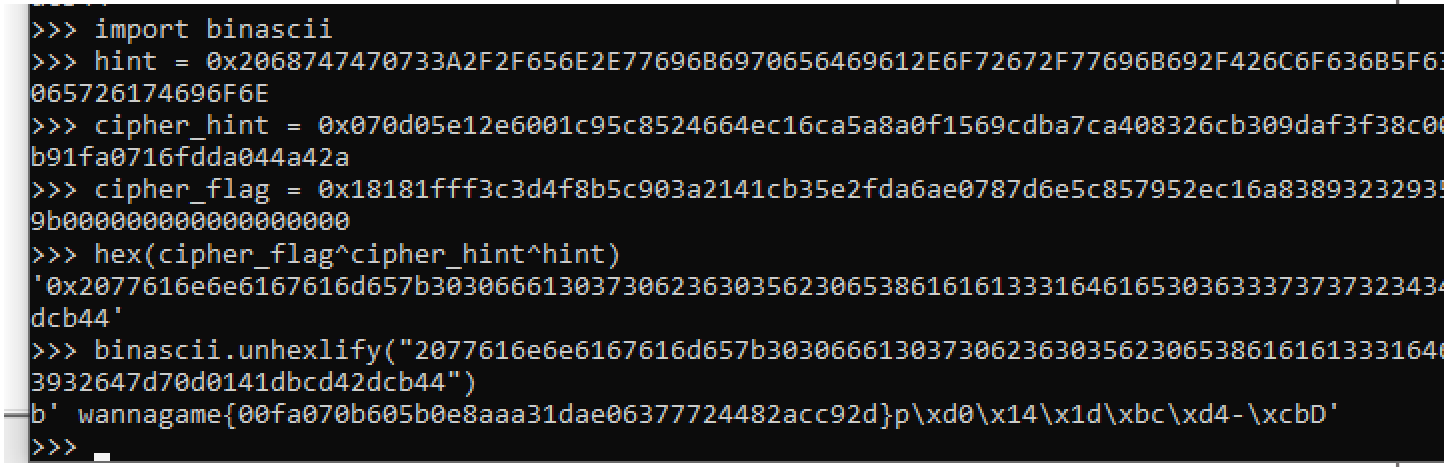
Nhưng đời đâu như mơ...

Chú ý: trong hint, có dấu cách trước https://



```
root@ThanhPN:~/RsaCtfTool# python3
Python 3.8.3 (default, May 14 2020, 11:03:12)
[GCC 9.3.0] on linux
Type "help", "copyright", "credits" or "license" for more information.
>>> import binascii
>>> hint = 0x2068747470733A2F2F656E2E77696B6970656469612E6F72672F77696B692F426C6F636B5F63
065726174696F6E
>>> cipher_hint = 0x070d05e12e6001c95c8524664ec16ca5a8a0f1569cdba7ca408326cb309daf3f38c00
b91fa0716fdda044a42a
>>> cipher_flag = 0x18181fff3c3d4f8b5c903a2141cb35e2fda6ae0787d6e5c857952ec16a838932329355
9b
>>> hex(cipher_flag^cipher_hint^hint)
'0x206f7971915d5a2ee639f3120ed896389a4698080d93f51e988d09e90e5e353bb69ff4f730c5a461e25dd5
a91df'
>>> binascii.unhexlify("206f7971915d5a2ee639f3120ed896389a4698080d93f51e988d09e90e5e353bb
bc6c6535e965d0bfaf842a91df")
b' oyq\x91]Z.\xe69\xf3\x12\x0e\xd8\x968\x9aF\x98\x08\r\x93\xf5\x1e\x98\x8d\t\xe9\x0e^5;\x
d52\xd3\x88\xf2\x89\xbcle5\xe9e\xd0\xbf\xaf\x84*\x91\xdf'
>>> 
```

Trong source code, khi mã hóa, mỗi vị trí trùng nhau chung một counter, còn khác nhau là khác counter, nên chúng ta phải cho độ dài 2 đoạn ciphertext bằng nhau bằng cách.. Thêm các số 0 vào sau cipher_flag để bằng độ dài cipher_int thì sẽ giải mã được



```
>>> import binascii
>>> hint = 0x2068747470733A2F2F656E2E77696B6970656469612E6F72672F77696B692F426C6F636B5F63
065726174696F6E
>>> cipher_hint = 0x070d05e12e6001c95c8524664ec16ca5a8a0f1569cdba7ca408326cb309daf3f38c00
b91fa0716fdda044a42a
>>> cipher_flag = 0x18181fff3c3d4f8b5c903a2141cb35e2fda6ae0787d6e5c857952ec16a838932329355
9b000000000000000000
>>> hex(cipher_flag^cipher_hint^hint)
'0x2077616e6e6167616d657b30306661303730623630356230653861616133316461653036333737373234343
dcb44'
>>> binascii.unhexlify("2077616e6e6167616d657b303066613037306236303562306538616161333164
3932647d70d0141dbcd42dcb44")
b' wannagame{00fa070b605b0e8aaa31dae06377724482acc92d}p\xd0\x14\x1d\xbc\xd4-\xcbD'
>>> 
```