Secret-Key Encryption Lab

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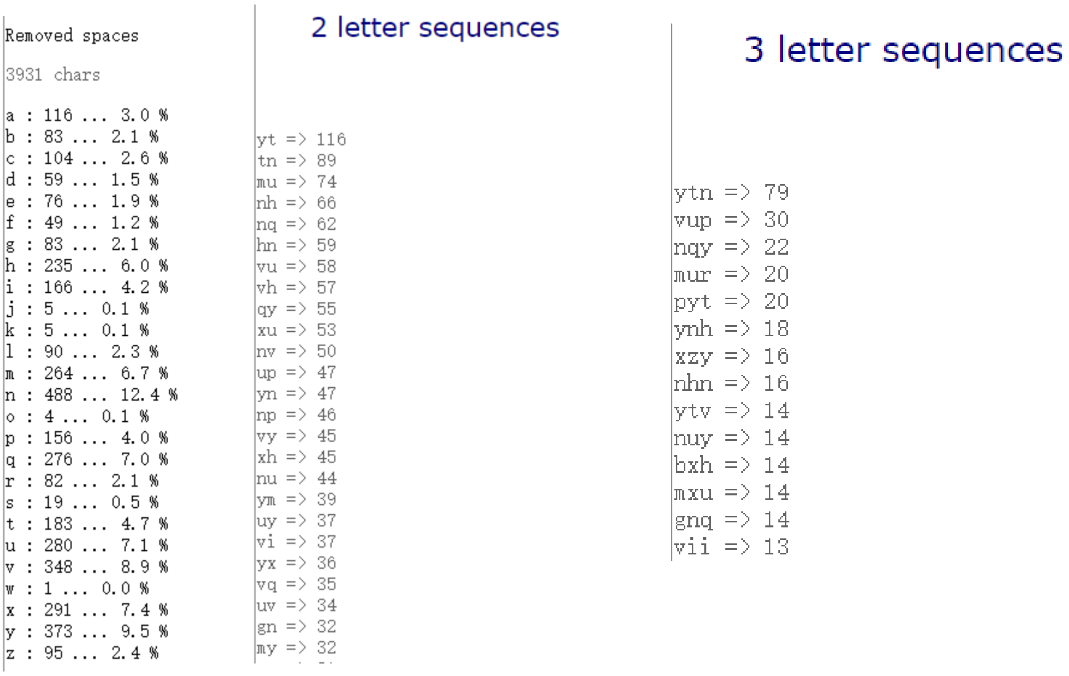
实验 1 Task 1: Frequency Analysis Against Monoalphabetic Substitution Cipher

从实验室网站上下载密文，传至所给网站中解析出各字母出现频率如下



```
Removed spaces

3931 chars

a : 116 ... 3.0 %
b : 83 ... 2.1 %
c : 104 ... 2.6 %
d : 59 ... 1.5 %
e : 76 ... 1.9 %
f : 49 ... 1.2 %
g : 83 ... 2.1 %
h : 235 ... 6.0 %
i : 166 ... 4.2 %
j : 5 ... 0.1 %
k : 5 ... 0.1 %
l : 90 ... 2.3 %
m : 264 ... 6.7 %
n : 488 ... 12.4 %
o : 4 ... 0.1 %
p : 156 ... 4.0 %
q : 276 ... 7.0 %
r : 82 ... 2.1 %
s : 19 ... 0.5 %
t : 183 ... 4.7 %
u : 280 ... 7.1 %
v : 348 ... 8.9 %
w : 1 ... 0.0 %
x : 291 ... 7.4 %
y : 373 ... 9.5 %
z : 95 ... 2.4 %
```

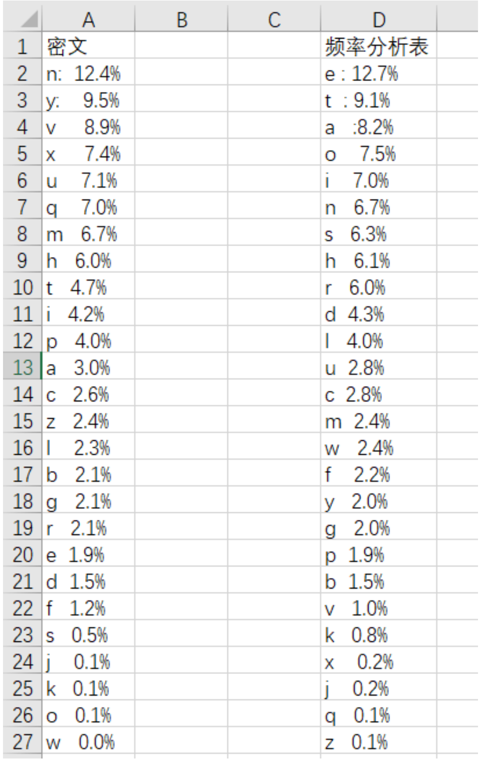
2 letter sequences

```
yt => 116
tn => 89
mu => 74
nh => 66
nq => 62
hn => 59
vu => 58
vh => 57
qy => 55
xu => 53
nv => 50
up => 47
yn => 47
np => 46
vy => 45
xh => 45
nu => 44
ym => 39
uy => 37
vi => 37
yx => 36
vq => 35
uv => 34
gn => 32
my => 32
```

3 letter sequences

```
ytn => 79
vup => 30
nqy => 22
mur => 20
pyt => 20
ynh => 18
xzy => 16
nhn => 16
ytv => 14
nuy => 14
bxh => 14
mxu => 14
gnq => 14
vii => 13
```

和频率分析表对比如下：



	A	B	C	D
1	密文			频率分析表
2	n: 12.4%			e : 12.7%
3	y: 9.5%			t : 9.1%
4	v 8.9%			a :8.2%
5	x 7.4%			o 7.5%
6	u 7.1%			i 7.0%
7	q 7.0%			n 6.7%
8	m 6.7%			s 6.3%
9	h 6.0%			h 6.1%
10	t 4.7%			r 6.0%
11	i 4.2%			d 4.3%
12	p 4.0%			l 4.0%
13	a 3.0%			u 2.8%
14	c 2.6%			c 2.8%
15	z 2.4%			m 2.4%
16	l 2.3%			w 2.4%
17	b 2.1%			f 2.2%
18	g 2.1%			y 2.0%
19	r 2.1%			g 2.0%
20	e 1.9%			p 1.9%
21	d 1.5%			b 1.5%
22	f 1.2%			v 1.0%
23	s 0.5%			k 0.8%
24	j 0.1%			x 0.2%
25	k 0.1%			j 0.2%
26	o 0.1%			q 0.1%
27	w 0.0%			z 0.1%

结合密文中 v 可单独出现，以及英文双字母的概率最大的 30 对字母按概率大小排列为：

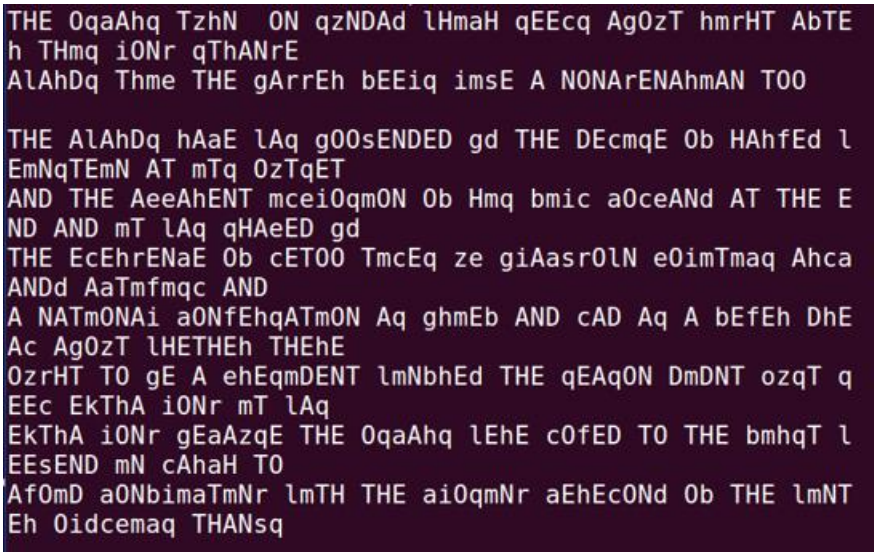
th he in er an re ed
on es st en at to nt
ha nd ou ea ng as or
ti is et it ar te se
hi of

概率最大的 20 组三字母按概率大小排列为：

the ing and her ere ent
tha nth was eth for dth
hat she ion his sth ers
ver

可以初步得出，y->T; t->H; n->E; v->A; u->N;p->D; x->O

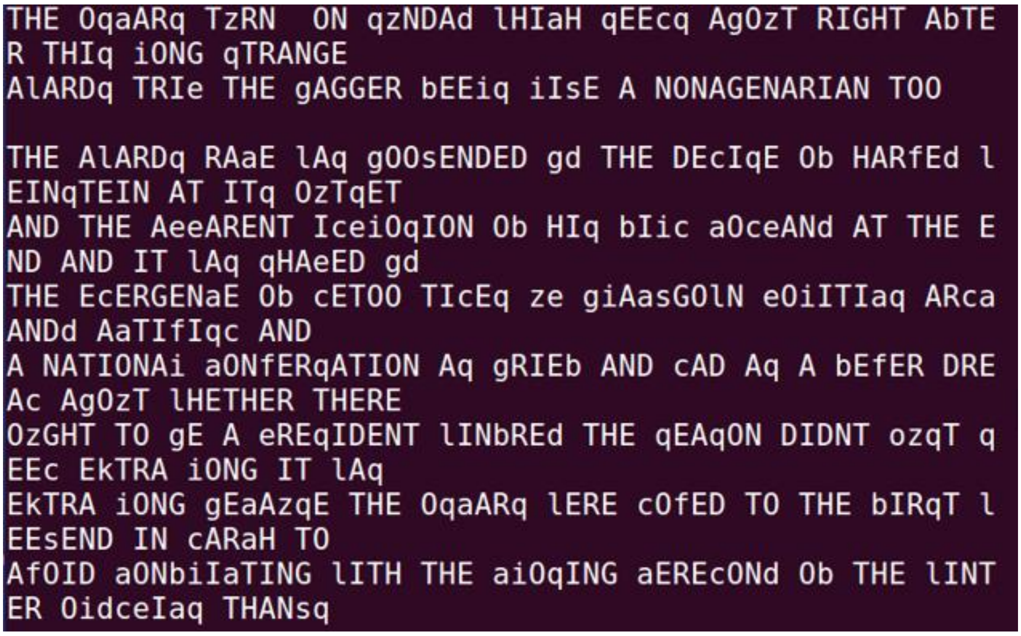
Tr 后输出文本如下



```
THE OqaAhq TzhN  ON qzNDAd lHmaH qEEcq AgOzT hmrHT AbTE
h THmq iONr qThANrE
AlAhDq Thme THE gArrEh bEEiq imsE A NONArENAhmAN TOO

THE AlAhDq hAaE lAq gOOsENDED gd THE DEcmqE Ob HAhfEd l
EmNqTEmN AT mTq OzTqET
AND THE AeeAhENT mceiOqmON Ob Hmq bmic aOceANd AT THE E
ND AND mT lAq qHAeED gd
THE EcEhrENaE Ob cETOO TmcEq ze giAasrOlN eOimTmaq Ahca
ANDd AaTmfmqc AND
A NATmONAi aONfEhqATmON Aq ghmEb AND cAD Aq A bEfEh DhE
Ac AgOzT lHETHEh THEhE
OzrHT TO gE A ehEqmDENT lmNbhEd THE qEAqON DmDNT ozqT q
EEc EkThA iONr mT lAq
EkThA iONr gEaAzqE THE OqaAhq lEhE cOfED TO THE bmhqT l
EEsEND mN cAhaH TO
AfOmD aONbimaTmNr lmTH THE aiOqmNr aEhEcONd Ob THE lmNT
Eh Oidcemaq THANsq
```

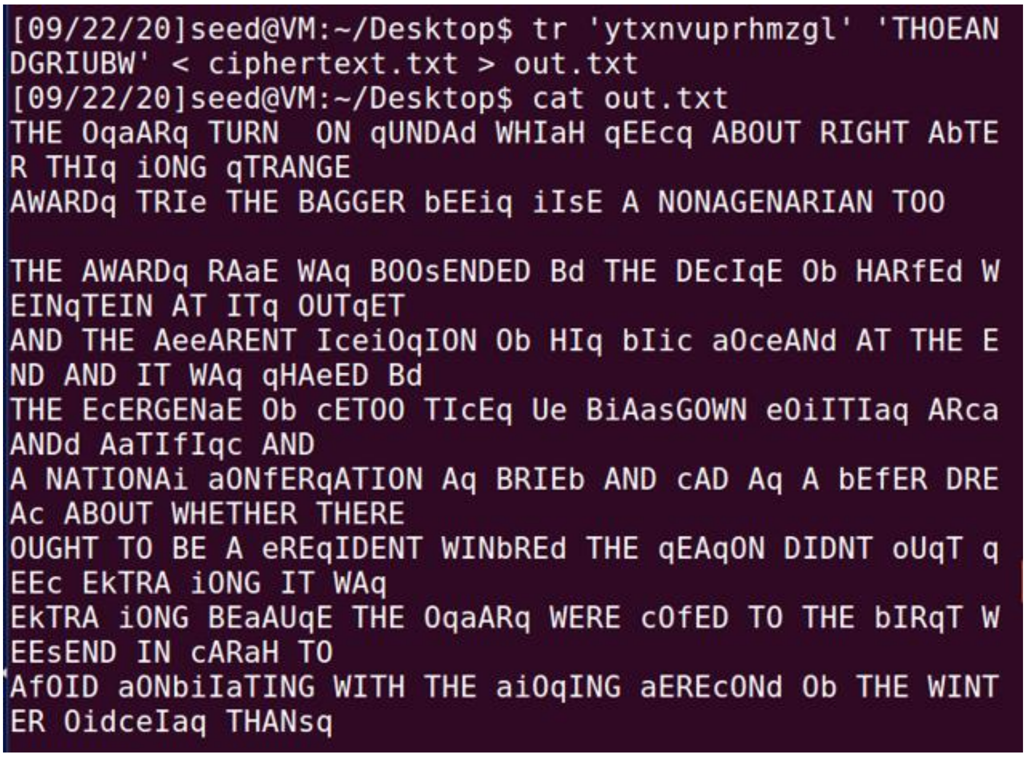
根据 NONArENAhmAN 一词，查阅发现仅有 NONAGENARIAN 能对应，故 r->G; h->R; m->I



```
THE OqaARq TzRN  ON qzNDAd lHIaH qEEcq AgOzT RIGHT AbTE
R THIq iONG qTRANGE
AlARDq TRIe THE gAGGER bEEiq iIsE A NONAGENARIAN TOO

THE AlARDq RAaE lAq gOOsENDED gd THE DEcIqE Ob HARfEd l
EINqTEIN AT ITq OzTqET
AND THE AeeARENT IceiOqION Ob HIq bIic aOceANd AT THE E
ND AND IT lAq qHAeED gd
THE EcERGENaE Ob cETOO TIcEq ze giAasGOlN eOiITIaq ARca
ANDd AaTIfIqc AND
A NATIONAi aONfERqATION Aq gRIEb AND cAD Aq A bEfER DRE
Ac AgOzT lHETHER THERE
OzGHT TO gE A eREqIDENT lINbREd THE qEAqON DIDNT ozqT q
EEc EkTRA iONG IT lAq
EkTRA iONG gEaAzqE THE OqaARq lERE cOfED TO THE bIRqT l
EEsEND IN cARaH TO
AfOID aONbiIaTING lITH THE aiOqING aERERcONd Ob THE lINT
ER OidceIaq THANsq
```

根据 TzRN, gAGGER, lERE 几词，及频率表可推测出 z->U；g->B; l->W

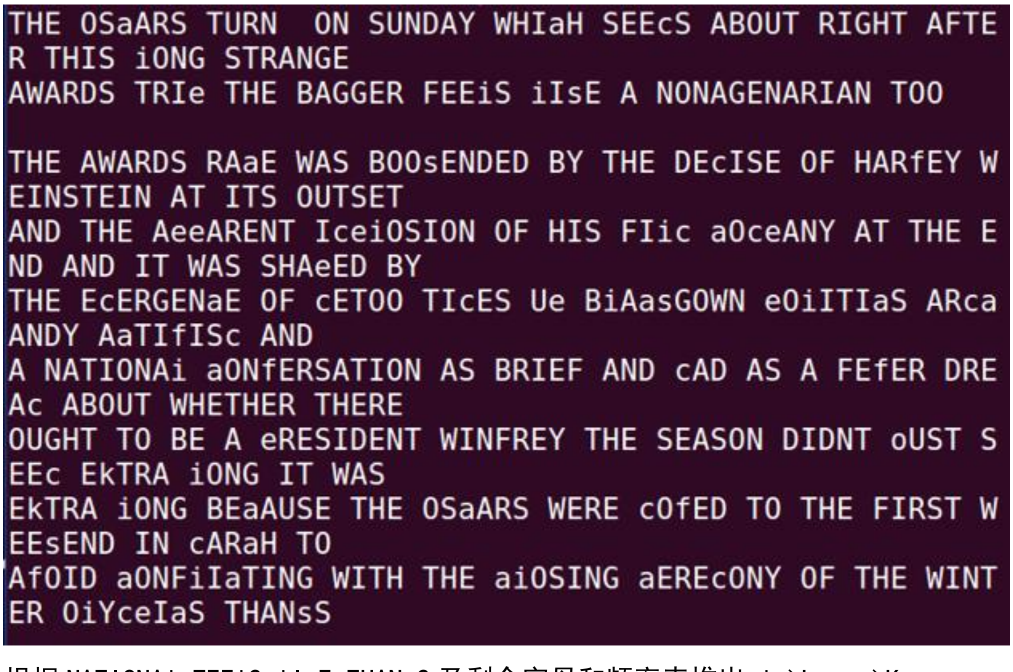


```
[09/22/20]seed@VM:~/Desktop$ tr 'ytxnvuprhmzgl' 'THOEAN
DGRIUBW' < ciphertext.txt > out.txt
[09/22/20]seed@VM:~/Desktop$ cat out.txt
THE OqaARq TURN  ON qUNDAd WHIaH qEEcq ABOUT RIGHT AbTE
R THIq iONG qTRANGE
AWARDq TRIe THE BAGGER bEEiq iIsE A NONAGENARIAN TOO

THE AWARDq RAaE WAq BOOsENDED Bd THE DEcIqE Ob HARfEd W
EINqTEIN AT ITq OUTqET
AND THE AeeARENT IceiOqION Ob HIq bIic aOceANd AT THE E
ND AND IT WAq qHAeED Bd
THE EcERGENaE Ob cETOO TIcEq Ue BiAasGOWN eOiITIaq ARca
ANDd AaTIfIqc AND
A NATIONAi aONfERqATION Aq BRIEb AND cAD Aq A bEfER DRE
Ac ABOUT WHETHER THERE
OUGHT TO BE A eREqIDENT WINbREd THE qEAqON DIDNT oUqT q
EEc EkTRA iONG IT WAq
EkTRA iONG BEaAUqE THE OqaARq WERE cOfED TO THE bIRqT W
EEsEND IN cARaH TO
AfOID aONbiIaTING WITH THE aiOqING aER,EcONd Ob THE WINT
ER OidceIaq THANsq
```

根据 THIq,qTRANGE 及频率表推出 q->S;根据语法、频率表、单词 Bd 推出 d->Y

根据剩余字母及频率表及 Ob 推出 b->F;



```
THE OSaARS TURN  ON SUNDAY WHIaH SEEcS ABOUT RIGHT AFTE
R THIS iONG STRANGE
AWARDS TRIe THE BAGGER FEEiS iIsE A NONAGENARIAN TOO

THE AWARDS RAaE WAS BOOsENDED BY THE DEcISE OF HARfEY W
EINSTEIN AT ITS OUTSET
AND THE AeeARENT IceiOSION OF HIS FIic aOceANY AT THE E
ND AND IT WAS SHAeED BY
THE EcERGENaE OF cETOO TIcES Ue BiAasGOWN eOiITIaS ARca
ANDY AaTIfISc AND
A NATIONAi aONfERSATION AS BRIEF AND cAD AS A FEfER DRE
Ac ABOUT WHETHER THERE
OUGHT TO BE A eRESIDENT WINFREY THE SEASON DIDNT oUST S
EEc EkTRA iONG IT WAS
EkTRA iONG BEaAUSE THE OSaARS WERE cOfED TO THE FIRST W
EEsEND IN cARaH TO
AfOID aONFiIaTING WITH THE aiOSING aEREcONY OF THE WINT
ER OiYceIaS THANsS
```

根据 NATIONAi FEEiS iIsE THANsS 及剩余字母和频率表推出 i->L; s->K

根据 FEfER DREAc 及剩余字母推出 f->V; c->M; 根据剩余字母及 EkTRA 推测出 k->X;

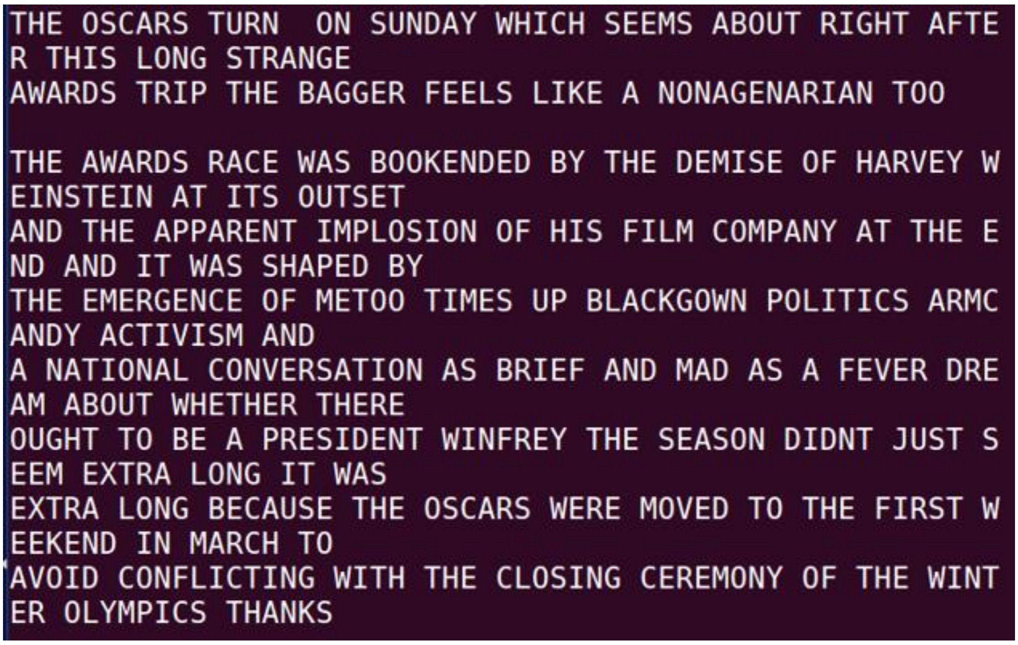
根据 WHIaH 及剩余字母推出 a->C;根据 Ue 及剩余字母推出 e->P;

根据 EjUALLY 及剩余字母推出 j->Q; 根据 oUST 及剩余字母推出 o->J; 剩余最后一对 w->Z

整理密钥对如下：

a->C	b->F	c->M	d->Y	e->P	f->V	g->B	h->R	i->L	j->Q	k->X

l->W | m->L | n->E | o->J | p->D | q->S | r->G | s->K | t->H | u->N | v->A | w->Z | x->O | y->T | z->U



```
THE OSCARS TURN  ON SUNDAY WHICH SEEMS ABOUT RIGHT AFTE
R THIS LONG STRANGE
AWARDS TRIP THE BAGGER FEELS LIKE A NONAGENARIAN TOO

THE AWARDS RACE WAS BOOKENDED BY THE DEMISE OF HARVEY W
EINSTEIN AT ITS OUTSET
AND THE APPARENT IMPLOSION OF HIS FILM COMPANY AT THE E
ND AND IT WAS SHAPED BY
THE EMERGENCE OF METOO TIMES UP BLACKGOWN POLITICS ARMC
ANDY ACTIVISM AND
A NATIONAL CONVERSATION AS BRIEF AND MAD AS A FEVER DRE
AM ABOUT WHETHER THERE
OUGHT TO BE A PRESIDENT WINFREY THE SEASON DIDNT JUST S
EEM EXTRA LONG IT WAS
EXTRA LONG BECAUSE THE OSCARS WERE MOVED TO THE FIRST W
EEKEND IN MARCH TO
AVOID CONFLICTING WITH THE CLOSING CEREMONY OF THE WINT
ER OLYMPICS THANKS
```

全部转换后明文如下

THE OSCARS TURN ON SUNDAY WHICH SEEMS ABOUT RIGHT AFTER THIS LONG STRANGE
AWARDS TRIP THE BAGGER FEELS LIKE A NONAGENARIAN TOO

THE AWARDS RACE WAS BOOKENDED BY THE DEMISE OF HARVEY WEINSTEIN AT ITS OUTSET
AND THE APPARENT IMPLOSION OF HIS FILM COMPANY AT THE END AND IT WAS SHAPED BY
THE EMERGENCE OF METOO TIMES UP BLACKGOWN POLITICS ARMCANDY ACTIVISM AND
A NATIONAL CONVERSATION AS BRIEF AND MAD AS A FEVER DREAM ABOUT WHETHER THERE
OUGHT TO BE A PRESIDENT WINFREY THE SEASON DIDNT JUST SEEM EXTRA LONG IT WAS
EXTRA LONG BECAUSE THE OSCARS WERE MOVED TO THE FIRST WEEKEND IN MARCH TO
AVOID CONFLICTING WITH THE CLOSING CEREMONY OF THE WINTER OLYMPICS THANKS
PYEONGCHANG

ONE BIG QUESTION SURROUNDING THIS YEARS ACADEMY AWARDS IS HOW OR IF THE
CEREMONY WILL ADDRESS METOO ESPECIALLY AFTER THE GOLDEN GLOBES WHICH BECAME
A JUBILANT COMINGOUT PARTY FOR TIMES UP THE MOVEMENT SPEARHEADED BY
POWERFUL HOLLYWOOD WOMEN WHO HELPED RAISE MILLIONS OF DOLLARS TO FIGHT SEXUAL
HARASSMENT AROUND THE COUNTRY

SIGNALING THEIR SUPPORT GOLDEN GLOBES ATTENDEES SWATHED THEMSELVES IN BLACK
SPORTED LAPEL PINS AND SOUNDED OFF ABOUT SEXIST POWER IMBALANCES FROM THE RED
CARPET AND THE STAGE ON THE AIR E WAS CALLED OUT ABOUT PAY INEQUITY AFTER
ITS FORMER ANCHOR CATT SADLER QUIT ONCE SHE LEARNED THAT SHE WAS MAKING FAR
LESS THAN A MALE COHOST AND DURING THE CEREMONY NATALIE PORTMAN TOOK A BLUNT

AND SATISFYING DIG AT THE ALLMALE ROSTER OF NOMINATED DIRECTORS HOW COULD THAT BE TOPPED

AS IT TURNS OUT AT LEAST IN TERMS OF THE OSCARS IT PROBABLY WONT BE

WOMEN INVOLVED IN TIMES UP SAID THAT ALTHOUGH THE GLOBES SIGNIFIED THE INITIATIVES LAUNCH THEY NEVER INTENDED IT TO BE JUST AN AWARDS SEASON CAMPAIGN OR ONE THAT BECAME ASSOCIATED ONLY WITH REDCARPET ACTIONS INSTEAD A SPOKESWOMAN SAID THE GROUP IS WORKING BEHIND CLOSED DOORS AND HAS SINCE AMASSED MILLION FOR ITS LEGAL DEFENSE FUND WHICH AFTER THE GLOBES WAS FLOODED WITH THOUSANDS OF DONATIONS OF OR LESS FROM PEOPLE IN SOME COUNTRIES

NO CALL TO WEAR BLACK GOWNS WENT OUT IN ADVANCE OF THE OSCARS THOUGH THE MOVEMENT WILL ALMOST CERTAINLY BE REFERENCED BEFORE AND DURING THE CEREMONY ESPECIALLY SINCE VOCAL METOO SUPPORTERS LIKE ASHLEY JUDD LAURA DERN AND NICOLE KIDMAN ARE SCHEDULED PRESENTERS

ANOTHER FEATURE OF THIS SEASON NO ONE REALLY KNOWS WHO IS GOING TO WIN BEST PICTURE ARGUABLY THIS HAPPENS A LOT OF THE TIME INARGUABLY THE NAILBITER NARRATIVE ONLY SERVES THE AWARDS HYPE MACHINE BUT OFTEN THE PEOPLE FORECASTING THE RACE SOCALLED OSCAROLOGISTS CAN MAKE ONLY EDUCATED GUESSES

THE WAY THE ACADEMY TABULATES THE BIG WINNER DOESNT HELP IN EVERY OTHER CATEGORY THE NOMINEE WITH THE MOST VOTES WINS BUT IN THE BEST PICTURE CATEGORY VOTERS ARE ASKED TO LIST THEIR TOP MOVIES IN PREFERENTIAL ORDER IF A MOVIE GETS MORE THAN PERCENT OF THE FIRSTPLACE VOTES IT WINS WHEN NO MOVIE MANAGES THAT THE ONE WITH THE FEWEST FIRSTPLACE VOTES IS ELIMINATED AND ITS VOTES ARE REDISTRIBUTED TO THE MOVIES THAT GARNERED THE ELIMINATED BALLOTS SECONDPLACE VOTES AND THIS CONTINUES UNTIL A WINNER EMERGES

IT IS ALL TERRIBLY CONFUSING BUT APPARENTLY THE CONSENSUS FAVORITE COMES OUT AHEAD IN THE END THIS MEANS THAT ENDOFSEASON AWARDS CHATTER INVARIABLY INVOLVES TORTURED SPECULATION ABOUT WHICH FILM WOULD MOST LIKELY BE VOTERS SECOND OR THIRD FAVORITE AND THEN EQUALLY TORTURED CONCLUSIONS ABOUT WHICH FILM MIGHT PREVAIL

IN IT WAS A TOSSUP BETWEEN BOYHOOD AND THE EVENTUAL WINNER BIRDMAN IN WITH LOTS OF EXPERTS BETTING ON THE REVENANT OR THE BIG SHORT THE PRIZE WENT TO SPOTLIGHT LAST YEAR NEARLY ALL THE FORECASTERS DECLARED LA LA LAND THE PRESUMPTIVE WINNER AND FOR TWO AND A HALF MINUTES THEY WERE CORRECT BEFORE AN ENVELOPE SNAFU WAS REVEALED AND THE RIGHTFUL WINNER MOONLIGHT WAS CROWNED

THIS YEAR AWARDS WATCHERS ARE UNEQUALLY DIVIDED BETWEEN THREE BILLBOARDS
OUTSIDE EBBING MISSOURI THE FAVORITE AND THE SHAPE OF WATER WHICH IS
THE BAGGERS PREDICTION WITH A FEW FORECASTING A HAIL MARY WIN FOR GET OUT

BUT ALL OF THOSE FILMS HAVE HISTORICAL OSCARVOTING PATTERNS AGAINST THEM THE
SHAPE OF WATER HAS NOMINATIONS MORE THAN ANY OTHER FILM AND WAS ALSO
NAMED THE YEARS BEST BY THE PRODUCERS AND DIRECTORS GUILDS YET IT WAS NOT
NOMINATED FOR A SCREEN ACTORS GUILD AWARD FOR BEST ENSEMBLE AND NO FILM HAS
WON BEST PICTURE WITHOUT PREVIOUSLY LANDING AT LEAST THE ACTORS NOMINATION
SINCE BRAVEHEART IN THIS YEAR THE BEST ENSEMBLE SAG ENDED UP GOING TO
THREE BILLBOARDS WHICH IS SIGNIFICANT BECAUSE ACTORS MAKE UP THE ACADEMYS
LARGEST BRANCH THAT FILM WHILE DIVISIVE ALSO WON THE BEST DRAMA GOLDEN GLOBE
AND THE BAFTA BUT ITS FILMMAKER MARTIN MCDONAGH WAS NOT NOMINATED FOR BEST
DIRECTOR AND APART FROM ARGO MOVIES THAT LAND BEST PICTURE WITHOUT ALSO
EARNING BEST DIRECTOR NOMINATIONS ARE FEW AND FAR BETWEEN

实验二 1. 破解维吉尼亚密码

观察密文，发现为字母数字组合，猜测原文中可能存在其他非字母字符，且可能需经过ASCII码转换，重合指数不便计算，于是采用暴力破解的方法

所用python代码如下：

```
def findindexkey(subarr):  # 该函数可以找出将密文subarr解密成可见字符的所有可能值
    visiable_chars = []  # 可见字符
    for x in range(32, 126):
        visiable_chars.append(chr(x))
    test_keys = []  # 用于测试密钥
    ans_keys = []  # 用于结果的返回
    for x in range(0x00, 0xFF):  # 枚举密钥里所有的值
        test_keys.append(x)
        ans_keys.append(x)
    for i in test_keys:  # 对于0x00~0xFF里的每一个数i和subarr里的每个值s异或
        for s in subarr:
            if chr(s ^ i) not in visiable_chars:  # 用i解密s，如果解密后明文不是可见字符，说明i不是密钥
                ans_keys.remove(i)  # 去掉ans_keys里测试失败的密钥
                break
    return ans_keys
```

strmi =

```
'F96DE8C227A259C87EE1DA2AED57C93FE5DA36ED4EC87EF2C63AAE5B9A7EFFD673BE4ACF7BE8923C\
AB1ECE7AF2DA3DA44FCF7AE29235A24C963FF0DF3CA3599A70E5DA36BF1ECE77F8DC34BE129A6CF4D126BF\
5B9A7CFEDF3EB850D37CF0C63AA2509A76FF9227A55B9A6FE3D720A850D97AB1DD35ED5FCE6BF0D138A84C\
C931B1F121B44ECE70F6C032BD56C33FF9D320ED5CDF7AFF9226BE5BDE3FF7DD21ED56CF71F5C036A94D96\
3FF8D473A351CE3FE5DA3CB84DDB71F5C17FED51DC3FE8D732BF4D963FF3C727ED4AC87EF5DB27A451D47E\
FD9230BF47CA6BFEC12ABE4ADF72E29224A84CDF3FF5D720A459D47AF59232A35A9A7AE7D33FB85FCE7AF5\
923AA31EDB3FF7D33ABF52C33FF0D673A551D93FFCD33DA35BC831B1F43CBF1EDF67F0DF23A15B963FE5DA\
36ED68D378F4DC36BF5B9A7AFFD121B44ECE76FEDC73BE5DD27AFCD773BA5FC93FE5DA3CB859D26BB1C63C\
ED5CDF3FE2D730B84CDF3FF7DD21ED5ADF7CF0D636BE1EDB79E5D721ED57CE3FE6D320ED57D469F4DC27A8\
5A963FF3C727ED49DF3FFFDD24ED55D470E69E73AC50DE3FE5DA3ABE1EDF67F4C030A44DDF3FF5D73EA250\
C96BE3D327A84D963FE5DA32B91ED36BB1D132A31ED87AB1D021A255DF71B1C436BF479A7AF0C13AA14794'
arr = []  # 密文，每个元素为字符的ascii码
for x in range(0, len(strmi), 2):
    arr.append(int(strmi[x:2 + x], 16))

for keylen in range(1,14):#枚举密钥的长度1~14
    sum=0
    for index in range(0,keylen):#对密钥里的第index个进行测试
        subarr=arr[index::keylen]#每隔keylen长度提取密文的内容，提取出来的内容都被密文的第index个加密
        sum+=calc_sum_of_Frequency_squares(subarr)
    sum = sum/keylen
    print("{}: {:.10f}".format(str(keylen),sum))

 # 计算各个子串平均频率平方和,发现keylen为7时最大，可能为密钥长



print('###############')
import string
def findindexkey2(subarr):#再造一个函数筛选密钥
    test_chars=string.ascii_letters+string.digits+','+'.'+'  '#将检查的字符改为
```

```
英文+数字+逗号+句号+空格
    test_keys=[]#用于测试密钥
    ans_keys=[]#用于结果的返回
    for x in range(0x00,0xFF):# 枚举密钥里所有的值
        test_keys.append(x)
        ans_keys.append(x)
    for i in test_keys:#对于 0x00~0xFF 里的每一个数 i 和 substr 里的每个值 s 异或
        for s in subarr:
            if chr(s^i) not in test_chars:#用 i 解密 s，如果解密后不是英文、数字、逗号、句号、空格，说明 i 不是密钥
                ans_keys.remove(i)#去掉 ans_keys 里测试失败的密钥
                break
    return ans_keys

vigenerekeys=[]#维基尼尔密码的密钥
for index in range(0,7):#已经知道密钥长度是 7
    subarr=arr[index::7]
    vigenerekeys.append(findindexkey2(subarr))
print(vigenerekeys)#输出的是[[186], [31], [145], [178], [83], [205], [62]].

print("#########")
ming=''
for i in range(0,len(arr)):
    ming=ming+chr(arr[i]^vigenerekeys[i%7][0])
print(ming)
```

得到明文如下

Cryptography is the practice and study of techniques for, among other things, secure communication in the presence of attackers. Cryptography has been used for hundreds, if not thousands, of years, but traditional cryptosystems were designed and evaluated in a fairly ad hoc manner. For example, the Vigenere encryption scheme was thought to be secure for decades after it was invented, but we now know, and this exercise demonstrates, that it can be broken very easily.

实验二：2. 以下密文使用了重复的一次一密密码，请通过异或运算和 ASCII 码的计算规律破解原始消息。

根据其为密钥重复型的一次一密密码，采用 MTP 攻击方式对其进行破解，所用代码如下：

```
#!/usr/bin/env python3

from typing import List
import binascii
import argparse

SPACE = ord(' ')


def main():
    parser = argparse.ArgumentParser(description='Many-time Pad Cracker')
    parser.add_argument(
        '--filename',
        type=str,
        help='Name of the file containing the ciphertexts (default: ciphertexts.txt)',
        default='ciphertexts.txt'
    )
    parser.add_argument(
        '-K', '--getkey',
        action='store_true',
        help='Print cracked key instead of cracked cleartexts.'
    )
    parser.add_argument(
        '-k', '--key',
        help='Encrypt messages with provided key.',
        default=''
    )
    args = parser.parse_args()
    try:
        with open(args.filename) as file:
            ciphertexts = [binascii.unhexlify(line.rstrip()) for line in file]
    except Exception as e:
        print('Cannot crack {} --- {}'.format(args.filename, e))
        raise SystemExit(-1)
    cleartexts = [bytearray(b'?' * len(line)) for line in ciphertexts]

    if args.key:
        decrypt(ciphertexts, cleartexts, args.key)
    else:
        crack(ciphertexts, cleartexts, args.getkey)


def decrypt(ciphertexts: List[bytes], cleartexts: List[bytearray], input_key: str) -> None:
    """ Decrypt ciphertexts using provided key and print cleartexts """
    key = binascii.unhexlify(input_key.rstrip())
    for row in range(len(ciphertexts)):
        for column in range(len(ciphertexts[row])):
            cleartexts[row][column] = ciphertexts[row][column] ^ key[column %
len(key)]
        print(cleartexts[row].decode('ascii'))


def crack(ciphertexts: List[bytes], cleartexts: List[bytearray], getkey: bool)
-> None:
    """ Try to decrypt ciphertexts and print cleartexts or key """
    max_length = max(len(line) for line in ciphertexts)
    key = bytearray(max_length)
    key_mask = [False] * max_length
    for column in range(max_length):  # go over characters from the beginning of
lines
        pending_ciphers = [line for line in ciphertexts if len(line) > column]
        for cipher in pending_ciphers:
            if is_space(pending_ciphers, cipher[column], column):
                key[column] = cipher[column] ^ SPACE
                key_mask[column] = True
                i = 0
                for clear_row in range(len(cleartexts)):
                    if len(cleartexts[clear_row]) != 0 and column <
len(cleartexts[clear_row]):
                        result = cipher[column] ^ pending_ciphers[i][column]
                        if result == 0:
                            cleartexts[clear_row][column] = SPACE
                        elif chr(result).isupper():  # XOR with space return
letter with swapped case
                            cleartexts[clear_row][column] =
ord(chr(result).lower())
                        elif chr(result).islower():  # XOR with space return
letter with swapped case
                            cleartexts[clear_row][column] =
ord(chr(result).upper())
                        i += 1
                break
    if getkey:
        for pos in range(max_length):
            if key_mask[pos]:
                print('{0:02x}'.format(key[pos]), end='')
            else:
                print('__', end='')
        print()
    else:
        print('\n'.join(line.decode('ascii') for line in cleartexts))


def is_space(rows: List[bytes], current: int, column: int) -> bool:
    """
    Return whether the current byte is encrypted space
    If the current byte is space, XORing with other bytes should return alpha
char or zero (when space)
    """
    for row in rows:
        result = row[column] ^ current
        if not (chr(result).isalpha() or result == 0):
            return False
    return True



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

解出来部分原文如下：

```
? am p?a?n?ng a s?cr?t missio??
?e is ?h? ?nly pe?so? to trus??
?he cu?r?n? plan ?s ?op secre??
?hen s?o?l? we me?t ?o do thi??
? thin? ?h?y shou?d ?ollow hi??
?his i? ?u?er tha? t?at one i??
?ot on? ?a?et is ?et?er than ??
```

根据密文结尾及英文语法单词猜测补全后如下：

I am planning a secret mission.
He is the only person to trust.
The current plan is top secret.
When should we meet to do this?
I think they should follow him.
This is ?u?er than that one i??
?ot on? ?a?et is better than ??

对第一句进行ASCII码转码

01001001 00100000 01100001 01101101 00100000 01110000 01101100 01100001 01101110
01101110 01101001 01101110 01100111 00100000 01100001 00100000 01110011 01100101
01100011 01110010 01100101 01110100 00100000 01101101 01101001 01110011 01110011
01101001 01101111 01101110 00101110

对第一句密文进行二进制转码

10111011 00111010 01100101 11110110 11110000 00000011 01001111 10101001 01010111
11110110 10100111 01100111 01101001 10011100 11100111 11111010 10111010 10000101
01011010 11111011 01001111 00101011 01010010 00001010 11101010 11010110 00010010

```
10010100 01001010 10000000 00011110
```

异或得到二进制密钥如下

```
11110010 00011010 00000100 10011011 11010000 01110011 00100011 11001000
00111001 10011000 11001110 00001001 00001110 10111100 10000110 11011010
11001001 11100000 00111001 10001001 00101010 01011111 01110010 01100111
10000011 10100101 01100001 11111101 00100101 11101110 00110000
```

对第二句进行ASCII码转码

```
01001000 01100101 00100000 01101001 01110011 00100000 01110100 01101000 01100101
00100000 01101111 01101110 01101100 01111001 00100000 01110000 01100101 01110010
01110011 01101111 01101110 00100000 01110100 01101111 00100000 01110100 01110010
01110101 01110011 01110100 00101110
```

对第二句密文进行二进制转码

```
10111010 01111111 00100100 11110010 10100011 01010011 01010111 10100000 01011100
10111000 10100001 01100111 01100010 11000101 10100110 10101010 10101100 10010010
01001010 11100110 01000100 01111111 00000110 00001000 10100011 11010001 00010011
10001000 01010110 10011010 00011110
```

解出密钥如下，与第一句解出的密钥相同，说明成功获取密钥

```
11110010 00011010 00000100 10011011 11010000 01110011 00100011 11001000
00111001 10011000 11001110 00001001 00001110 10111100 10000110 11011010
11001001 11100000 00111001 10001001 00101010 01011111 01110010 01100111
10000011 10100101 01100001 11111101 00100101 11101110 00110000
```

对密钥进行十六进制转码后如下

```
f2 1a 04 9b d0 73 23 c8 39 98 ce 09 0e bc 86 da c9 e0 39 89 2a 5f 72 67 83 a5 61
fd 25 ee 30
```

因为部分字符无法显示所以就放出十六进制的密钥

最终根据密钥解出明文如下：

I am planning a secret mission.
He is the only person to trust.
The current plan is top secret.
When should we meet to do this?
I think they should follow him.
This is purer than that one is.
Not one cadet is better than I.