Crypto Lab
Sec-250
Your Name Here

Caesar Cipher

Caesar Cipher uses a key called a Shift, which transposes cleartext ‘x’ amount of times to the right, which results in ciphertext.

cleartext	c	a	t
Shift (Rotate +10)			
ciphertext	m	k	d

Encrypt & decrypt the following **without** online resources, just like the Romans!

1. (ROT3) Smegael = vphjdho
2. (ROT4) Frodo = jvshs
3. (ROT9) Gandalf = pjwmjuo
4. (ROT13) Caesar salad= pnrfne fnynq

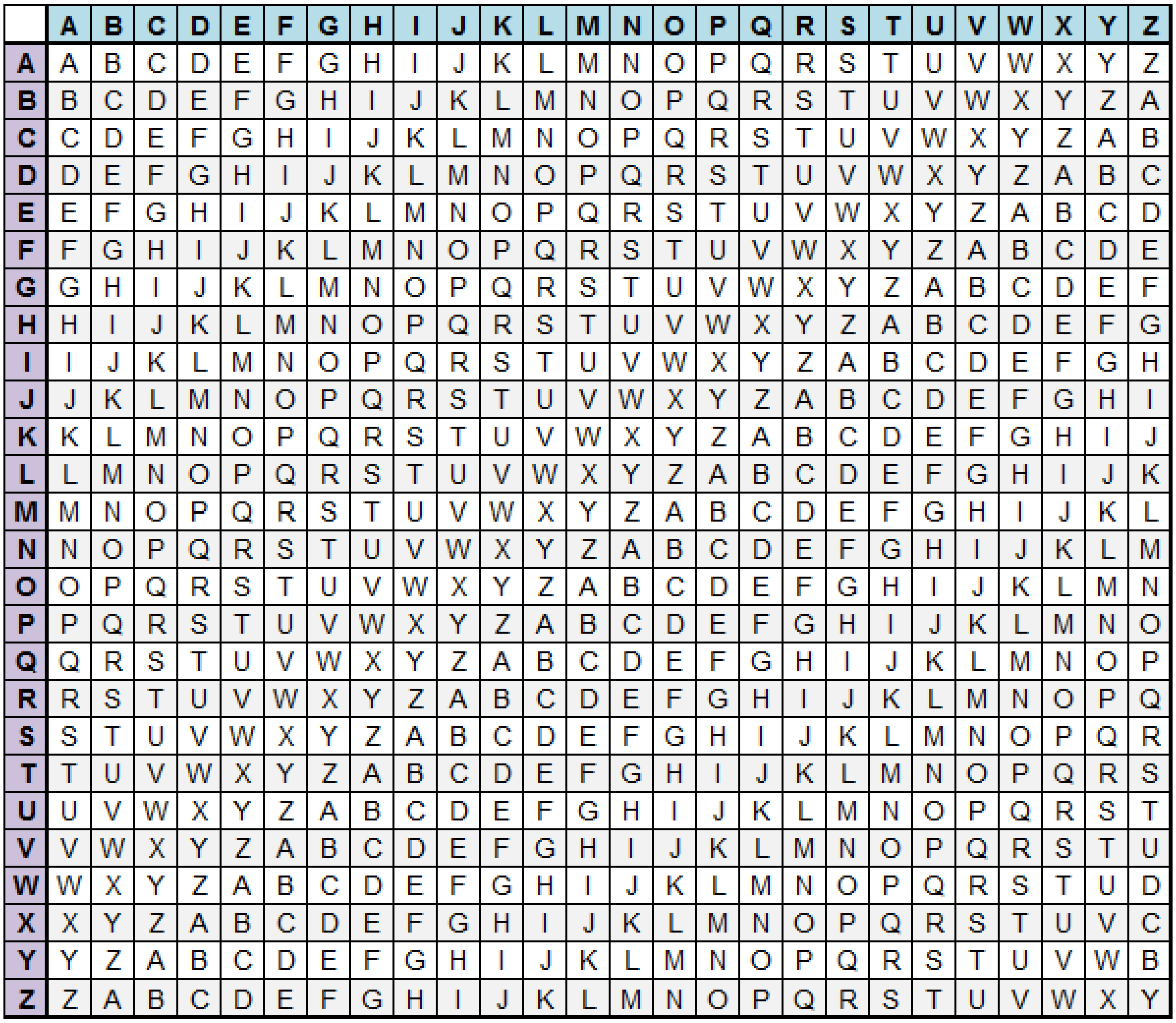
Brute force time ... There’s no shift provided, so try all possibilities to decode!

5. They are taking the hobbits to isengard = Maxr tkx mtdbgz max ahuubml mh blxgztkw.
6. What is the shift? ROT19

____

Vigenère

Vigenère technique switches the alphabet used on each letter (called polyalphabetic), based upon a secret keyword. We start with a table of shifted alphabets:



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
A	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
B	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A
C	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B
D	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C
E	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D
F	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E
G	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F
H	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G
I	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H
J	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I
K	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J
L	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K
M	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L
N	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M
O	O	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N
P	P	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
Q	Q	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
R	R	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q
S	S	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R
T	T	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S
U	U	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
V	V	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U
W	W	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	D
X	X	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	C
Y	Y	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	B
Z	Z	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y

Now, let’s encode the message “cyber is life” using the keyword “cncs”. We start by repeating the key underneath the message, so the letters line up:

Message:	c	y	b	e	r	i	s	l	i	f	e
Key:	c	n	c	s	c	n	c	s	c	n	s
Encrypted:	e	l	d	w	t	v	u	d	k	s	w

Now, look for the row marked ‘c’ in the left-most column (the key), and the ‘c’ in the top-most row (plaintext). The intersection of that column and row contains ‘e’ (ciphertext).

7. Rinse & repeat for the remaining cyphertext, again **without** online resources … Vive le cryptage!

Railfence

When you rearrange plaintext in a "wave" pattern (down, down, up, up, down, down, etc.), it is called railfence encryption.

Ex: This plaintext of “happy” looks like this with 3 rails (read: 3 rows) -

```
h       y
  a   p
    p
```

Then when read line-by-line, we get the cypertext of “hyapp”.

8. Decrypt the following ciphertext “crsyectba” built using 3 rails.

c				r				s
	y		e		c		t	
		b				a		

Cybercats

9. Is Railfence a substitution or transposition cipher? Explain why. It is transposition as you are not altering any of the characters but rather moving them around.

Hashes

We learned how different hash functions produce a unique fixed string of data that should always match to verify data integrity, as long as the data doesn't change.

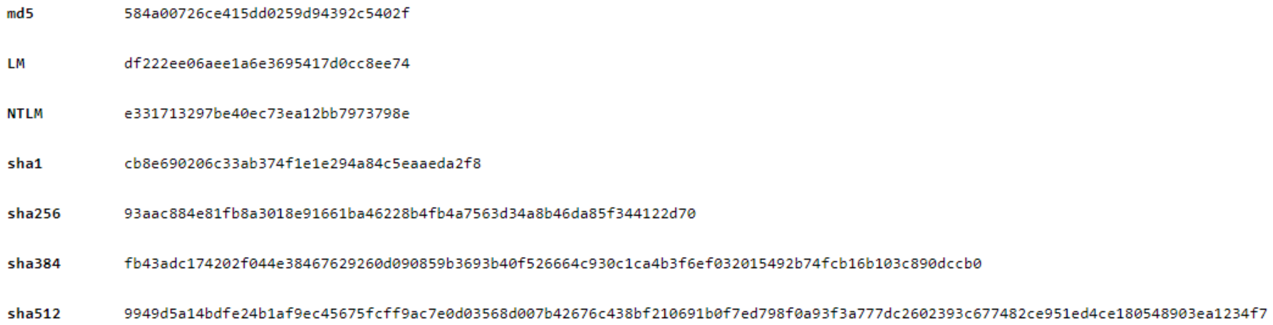
1. Open a browser to : https://defuse.ca/checksums.htm
2. Enter the following phrase into the text area:

    Cryptography is as much fun as a person can have!

    a. Click "Calculate Checksums"

    Are the checksum lengths the same? No
    How many characters long is each checksum?
    MD5 32
    SHA1 40
    SHA512 128

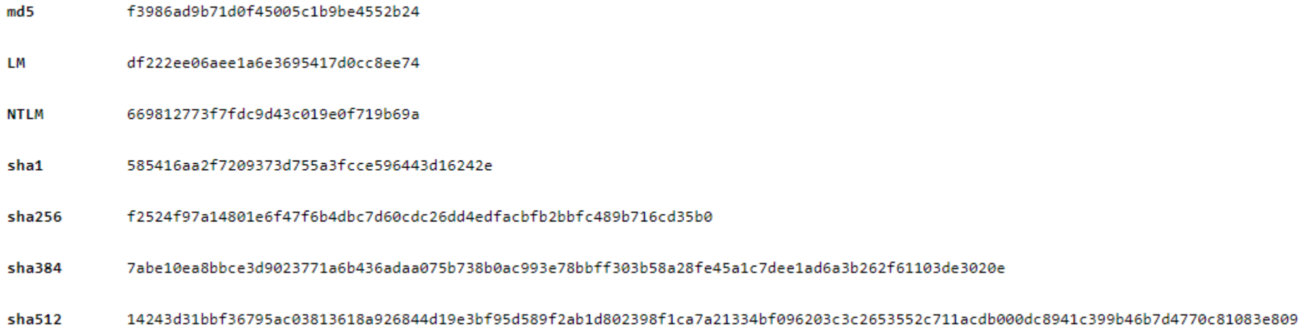
    b. Please take a Snip of results!



```
md5        584a00726ce415dd0259d94392c5402f

LM         df222ee06aee1a6e3695417d0cc8ee74

NTLM       e331713297be40ec73ea12bb7973798e

sha1       cb8e690206c33ab374f1e1e294a84c5eaaeda2f8

sha256     93aac884e81fb8a3018e91661ba46228b4fb4a7563d34a8b46da85f344122d70

sha384     fb43adc174202f044e38467629260d090859b3693b40f526664c930c1ca4b3f6ef032015492b74fcb16b103c890dccb0

sha512     9949d5a14bdfe24b1af9ec45675fcff9ac7e0d03568d007b42676c438bf210691b0f7ed798f0a93f3a777dc2602393c677482ce951ed4ce180548903ea1234f7
```

    c.

3. Change the phrase you typed in by removing one character and click "Calculate."
    a. Is the checksum different from the previous computation? Yes, but has the same amount of characters.
    b. Please take a Snip of results



```
md5        f3986ad9b71d0f45005c1b9be4552b24

LM         df222ee06aee1a6e3695417d0cc8ee74

NTLM       669812773f7fdc9d43c019e0f719b69a

sha1       585416aa2f7209373d755a3fcce596443d16242e

sha256     f2524f97a14801e6f47f6b4dbc7d60cdc26dd4edfacbfb2bbfc489b716cd35b0

sha384     7abe10ea8bbce3d9023771a6b436adaa075b738b0ac993e78bbff303b58a28fe45a1c7dee1ad6a3b262f61103de3020e

sha512     14243d31bbf36795ac03813618a926844d19e3bf95d589f2ab1d802398f1ca7a21334bf096203c3c2653552c711acdb000dc8941c399b46b7d4770c81083e809
```

4. Next, we going to explore HMAC by opening up http://beautifytools.com/hmac-generator.php
5. Copy the same phase into the text box, then type a random string of text in the box "Key" that is displayed when you clicked on HMAC.
    a. Be sure your key is different than your partners.
    b. Is your HMAC checksum the same as your partners? Why or why not? No because we used different keys

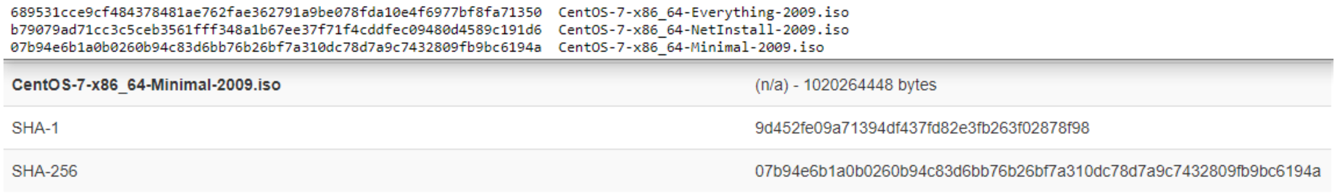
6. Both of you type in “SEC250” as the HMAC key.
    a. Is the checksum the same for you and your partners? Why or Why not? They are the same because the cipher key is the same.

7. Now, let’s download & check an [ISO’s](ISO’s) integrity, something you’ll be doing in our program frequently.
8. First, download the CentOS-7 Minimal 1908 ISO here: http://ftp.linux.ncsu.edu/pub/CentOS/7/isos/x86_64/
    a. FYI: This is a popular Linux OS we use in CNCS
9. Also, open the sha265.sum.txt file. This checksum is what we are going to check the download’s checksum against.
10. Now, let’s go to https://md5file.com/calculator and select the ISO you just downloaded.
11. Once finished calculating, you should see its SHA-256 checksum.

a. Do the both sets of checksums match? Yes 07b94e6b1a0b0260b94c83d6bb76b26bf7a310dc78d7a9c7432809fb9bc6194a

b. 07b94e6b1a0b0260b94c83d6bb76b26bf7a310dc78d7a9c7432809fb9bc6194a

c. Provide one Snip including <u>both</u> the md5file.com’s checksum + the sha1sum.txt file’s checksum, validating the ISO’s integrity.

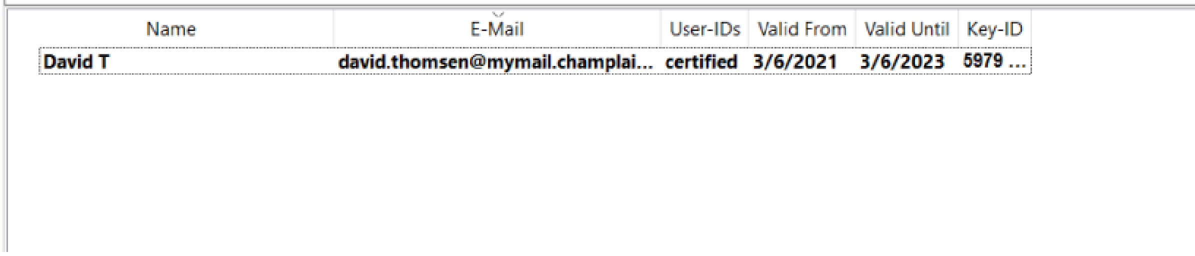


```
689531cce9cf484378481ae762fae362791a9be078fda10e4f6977bf8fa71350  CentOS-7-x86_64-Everything-2009.iso
b79079ad71cc3c5ceb3561fff348a1b67ee37f71f4cddfec09480d4589c191d6  CentOS-7-x86_64-NetInstall-2009.iso
07b94e6b1a0b0260b94c83d6bb76b26bf7a310dc78d7a9c7432809fb9bc6194a  CentOS-7-x86_64-Minimal-2009.iso
```

CentOS-7-x86_64-Minimal-2009.iso	(n/a) - 1020264448 bytes
SHA-1	9d452fe09a71394df437fd82e3fb263f02878f98
SHA-256	07b94e6b1a0b0260b94c83d6bb76b26bf7a310dc78d7a9c7432809fb9bc6194a

<u>Fun with Public-Private Keys!</u>

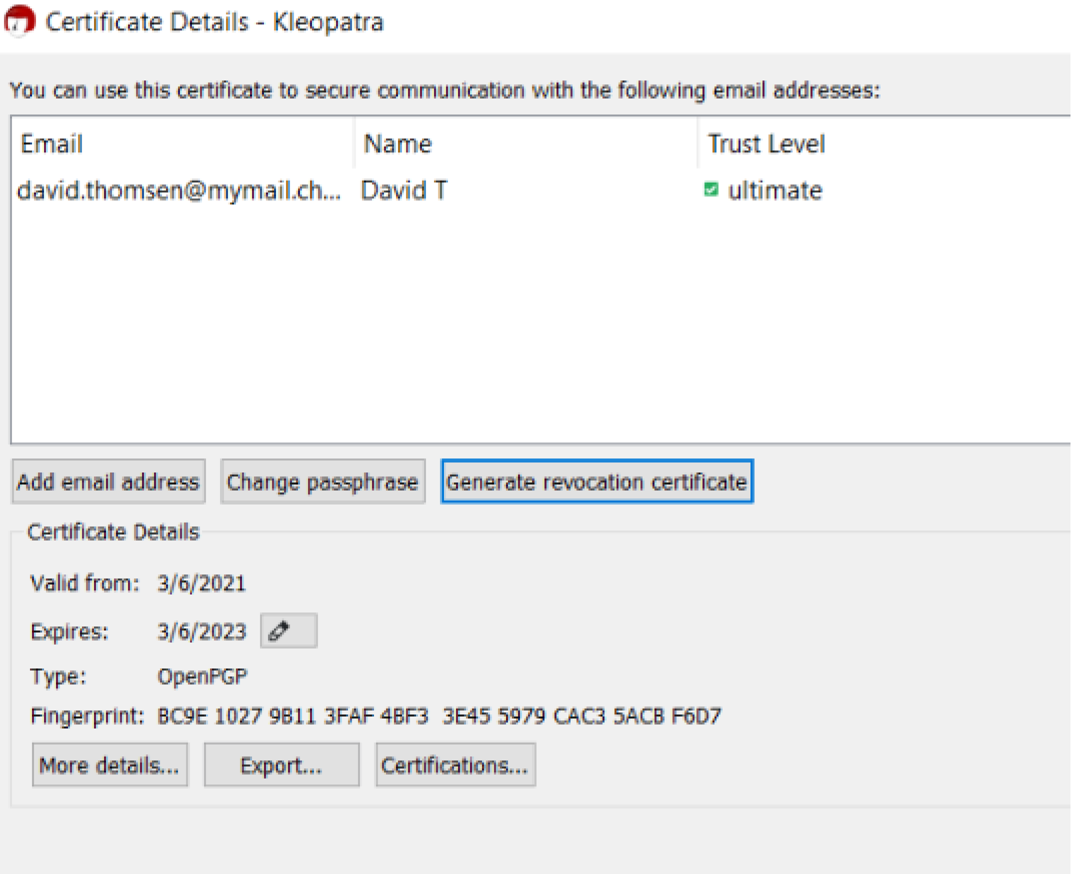
1. Download from gpg4win.org (select $0 to download for free) on your Windows 10 VM.
    a. There’s an extensive product tech guide with screenshots on how to install & operate this tool → https://files.gpg4win.org/doc/gpg4win-compendium-en.pdf
    b. Of course, it’s a bit out of date, so the screens nor items may not be exactly the same (because everything online is perfect, right?).
    c. Your mission: Be curious, explore, test, and win!
    d. FYI: This is a small taste of higher level courses.
2. Start the install once downloaded:
    a. Achtung! → During the install, please select **<u>ALL</u>** Components to install.
3. Creating a Key pair & Digital Certificate:
    a. File > Key Pair > Create a personal OpenPGP key pair
    b. Insert your First & Last name, along with an email address.
    c. Show all details
        i. Snip for your details.



Name	E-Mail	User-IDs	Valid From	Valid Until	Key-ID
David T	**david.thomsen@mymail.champlai...**	**certified**	**3/6/2021**	**3/6/2023**	**5979 ...**

    d. Create a passphrase for your private key; strong + something you will NEVER forget

i. Snip your successfully created key pair’s Fingerprint



Certificate Details - Kleopatra

You can use this certificate to secure communication with the following email addresses:

Email	Name	Trust Level
david.thomsen@mymail.ch...	David T	✓ ultimate

Certificate Details

Valid from: 3/6/2021

Expires: 3/6/2023

Type: OpenPGP

Fingerprint: BC9E 1027 9B11 3FAF 4BF3 3E45 5979 CAC3 5ACB F6D7

4. File > Export your Secret Keys & name your output file your First_Last name, and then save it.
   a. Just like your car keys, please do not share nor lose this!
5. Now, open up a new program on your desktop, GPA or GNU Privacy Assistant
6. Once opened, you get what’s about to happen … Key Management!
7. You should see your public & private key pair (gold + light blue-ish keys) with your name & email.
8. Download another key from https://ssl.intevation.de/Intevation-Distribution-Key.asc and save it to your Desktop.
   a. In the key that you download, note that everything between and including the blocks

      -----BEGIN PGP PUBLIC KEY BLOCK-----
      -----END PGP PUBLIC KEY BLOCK----

      …pertain to the public key.

      Everything else in the file is ignored. If the block heading “-----BEGIN PGP PUBLIC KEY BLOCK-----” and/or “-----END PGP PUBLIC KEY BLOCK----” are missing, then the file will be ignored as not having a valid public key.
9. Open the file that you downloaded so you learn to recognize a valid public key.
10. Import the new key from your desktop, and after selecting it, you should get a message that 2 public keys are read & imported.
11. Right-click the keys, and now you can sign both which sets the trust for the keys after you've verified it is legit. (Here, we are assuming the verification process has occurred!)
    a. There’s a key created on 2010 & another on 2016. When selecting the Details tab …

i. What are the Key Types? rsa3072 & dsa1024
ii. What are their precise expiration dates? 11-02-21 & 03-16-2020
iii. What level is the Owner Trust (that’s you!)? Unknown

12. Right-click on both keys, and Set Owners Trust to “ultimate”
    a. This is part of that “Web of Trust” which makes online security a thing!
    b. What level is the Owner Trust on the keys now? Ultimate