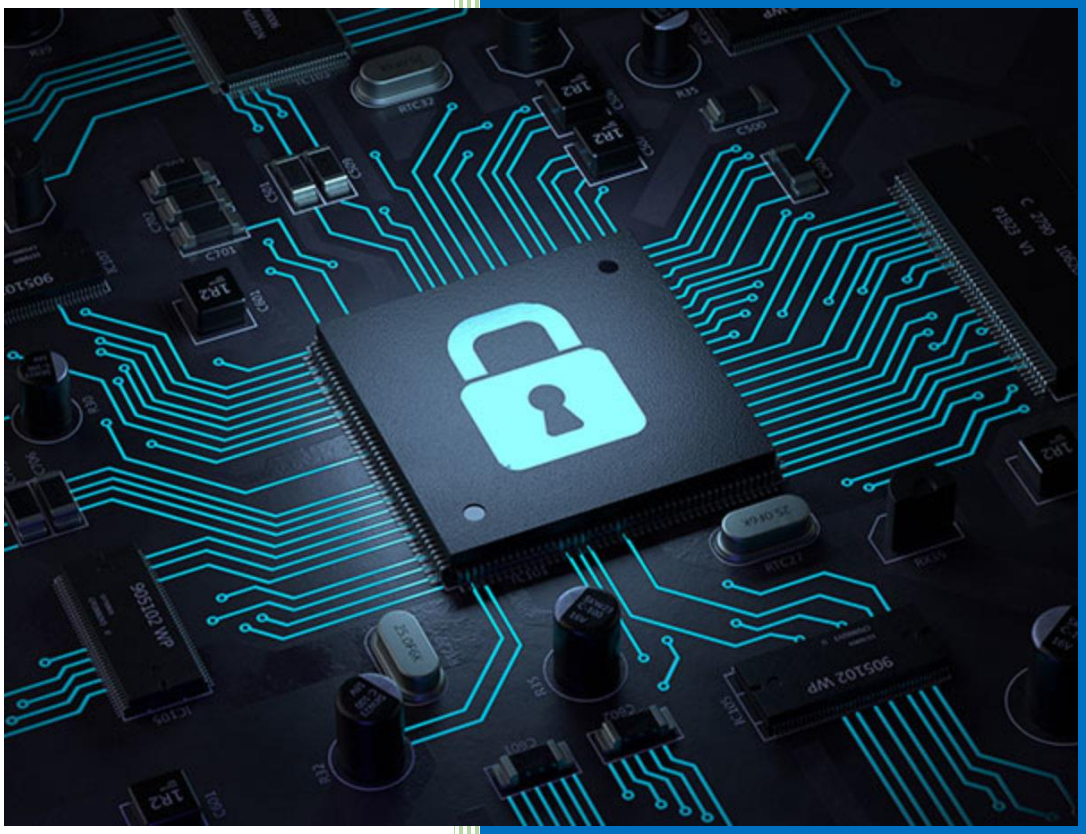
FAKULTI TEKNOLOGI
KEJURUTERAAN KELAUTAN
DAN INFORMATIK

2020/2021

CYBER SECURITY



Lab 3: Cryptography

VERSION 1

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Revision History

Revision Date	Previous Revision Date	Summary of Changes	Changes Marked
30/03/2021		First Issue	Fakhrul Adli Mohd Zaki Dr Farizah Yunus

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CONTENTS

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INSTRUCTIONS

Manual makmal ini adalah untuk kegunaan pelajar-pelajar Fakulti Teknologi Kejuruteraan Kelautan dan Informatik (FTKKI), Universiti Malaysia Terengganu (UMT) sahaja. Tidak dibenarkan mencetak dan mengedar manual ini tanpa kebenaran rasmi daripada penulis.

Sila ikuti langkah demi langkah sebagaimana yang dinyatakan di dalam manual.

Arahan laporan makmal:

a) Pelajar perlu menyediakan laporan makmal untuk aktiviti makmal.
b) Kandungan laporan makmal mesti terdiri daripada beberapa tangkapan skrin untuk semua tetapan makmal keselamatan maya yang berjaya dengan beberapa penjelasan.
c) Jawab semua soalan refleksi untuk setiap sesi makmal.
d) Pelajar dapat memberikan senarai rujukan untuk rujukan tambahan.
e) Laporan makmal mesti dihantar dalam masa yang diberikan menggunakan pautan yang disediakan di platform eLearning.

This laboratory manual is for use by the students of the Faculty of Ocean Engineering Technology and Informatics, Universiti Malaysia Terengganu (UMT) only. It is not permissible to print and distribute this manual without the official authorisation of the author.

Please follow step by step as described in the manual.

Lab report instructions:

a) Students need to prepare lab report for lab activities.
b) The contents of the lab report must consist of several screenshots for all successful setting of virtual security lab with some explanation.
c) Answer all the reflection questions for every lab sessions.
d) Student can provide the list of references for extra references.
e) *Lab report must be submitted within the time given using the provided link in the eLearning platform.*

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TASK 1: INSTALLING A HASH CHECKING TOOL

OBJECTIVE

To download and install a hash checking tool

TASK DESCRIPTION

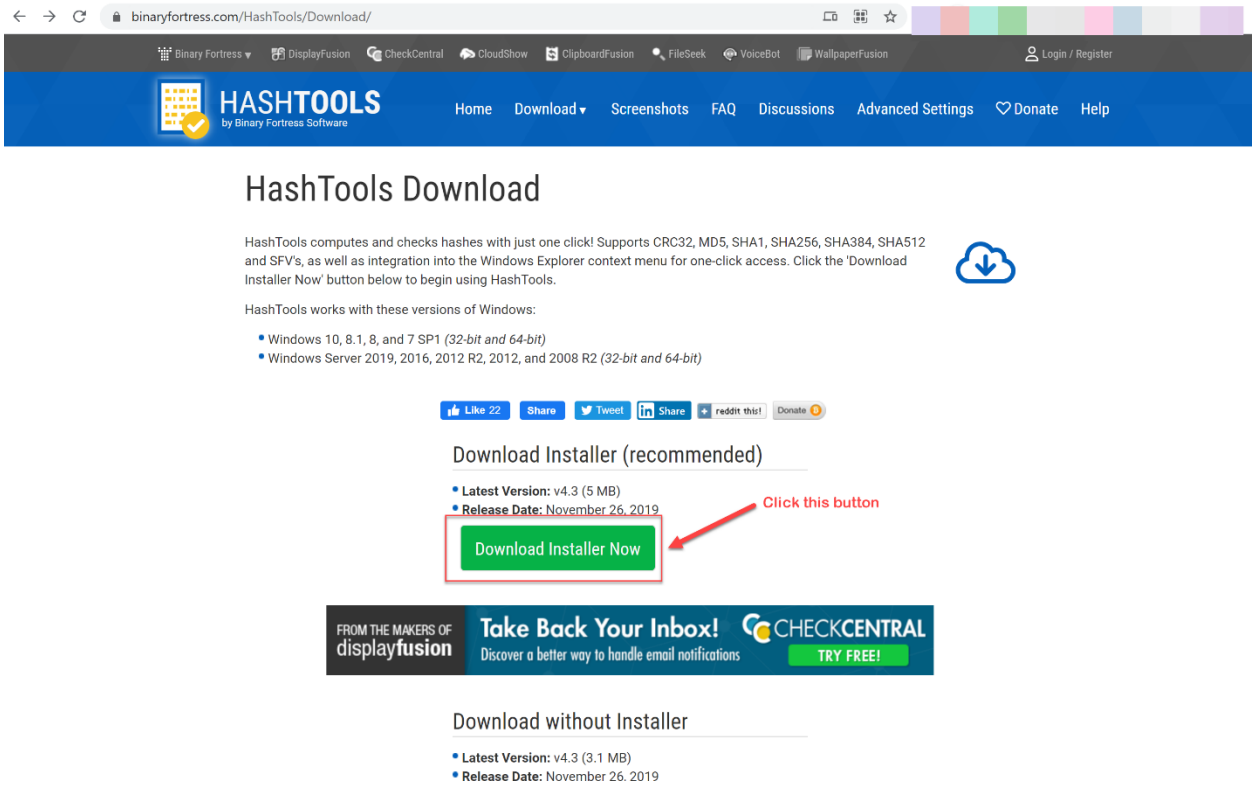
The student is required to download a hash checking tool known as HashTools from the given link. Then, student needs to install it to their computer. This tool later will be used to check the integrity of the downloaded program in Task 2.

ESTIMATED TIME

30 Minutes

STEPS:

1. Using your web browser, go to https://www.binaryfortress.com/HashTools/Download/ to download a tool that has been equipped with various hash functions such as CRC32, MD5, SHA1, SHA256, SHA384 and SHA512.
2. Click the button as shown in the below screenshot:



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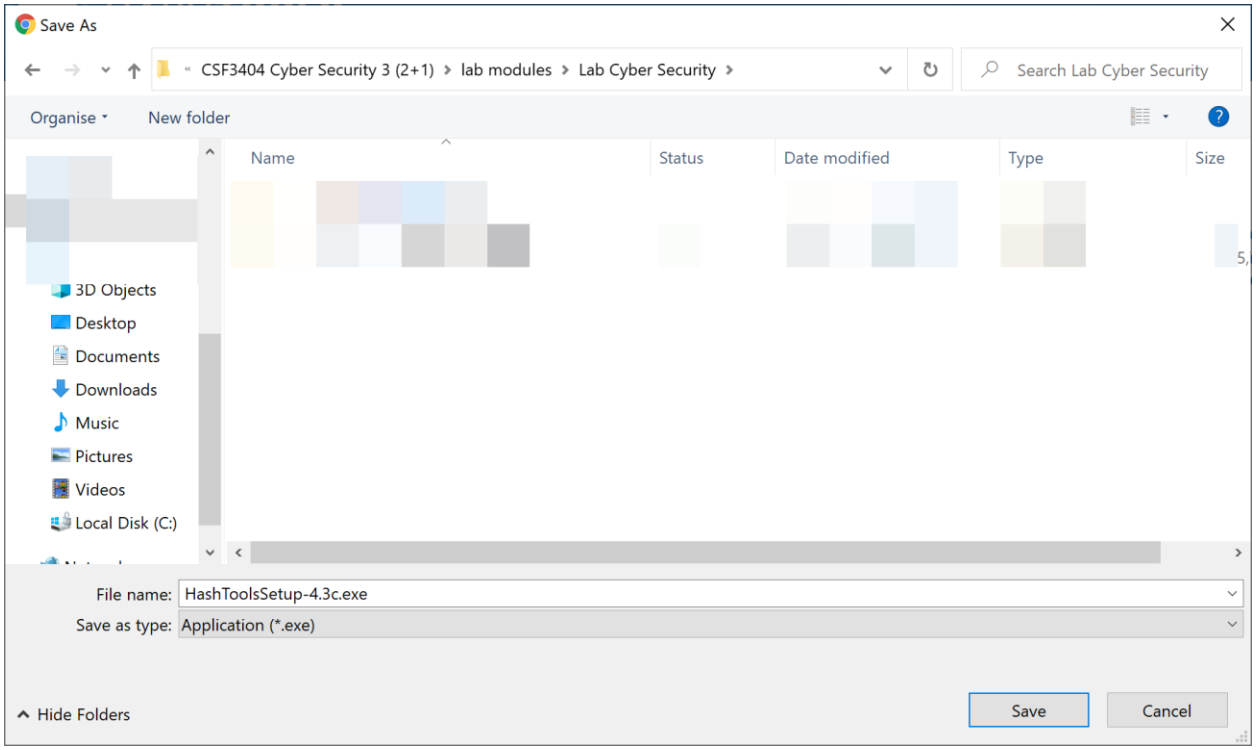
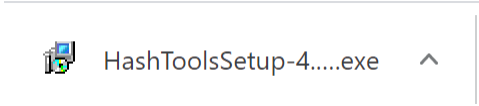
3. Save the file at a suitable location where it is easy for you to find it later.

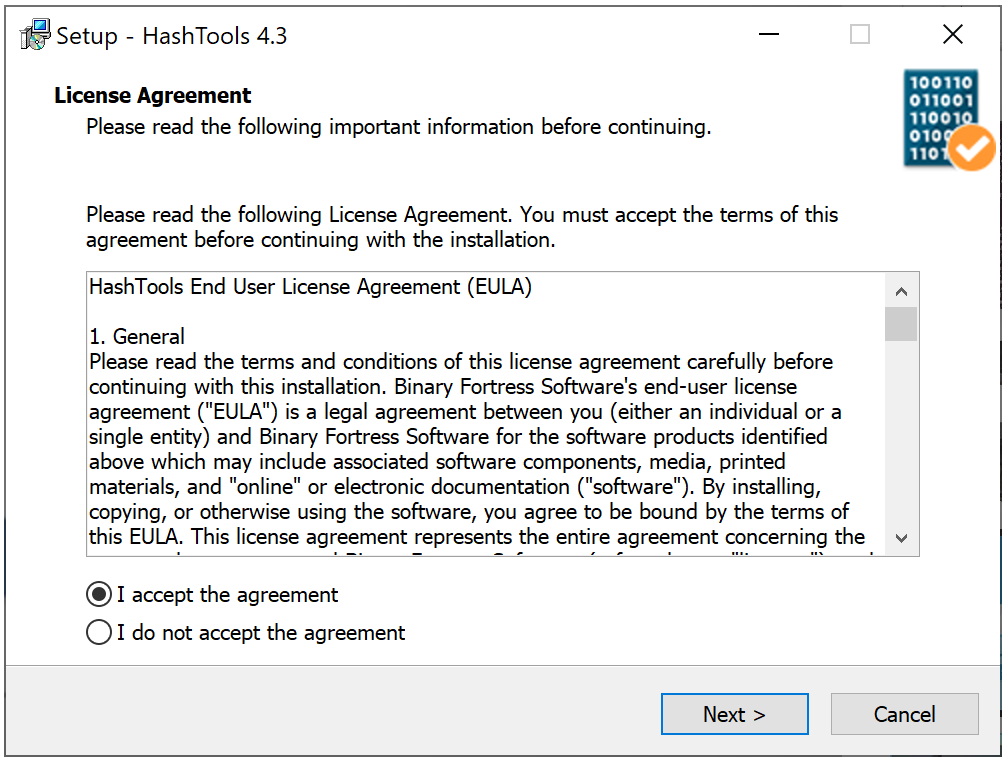


4. After finish the download, you may simply click on the installer icon

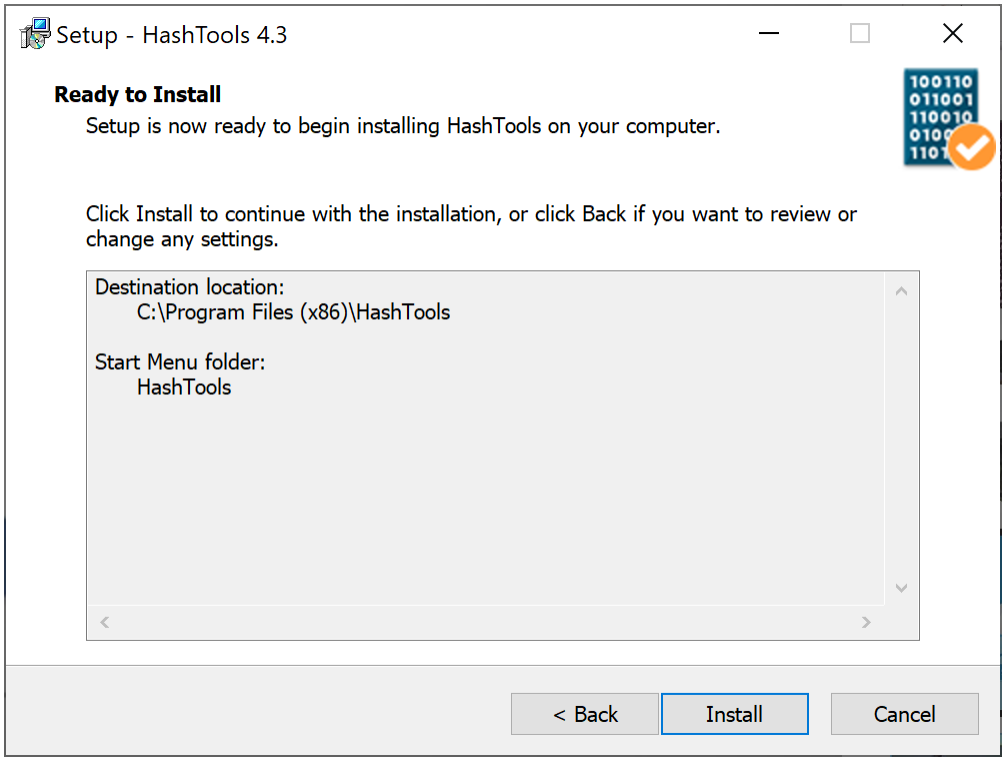


to install the program on your computer.

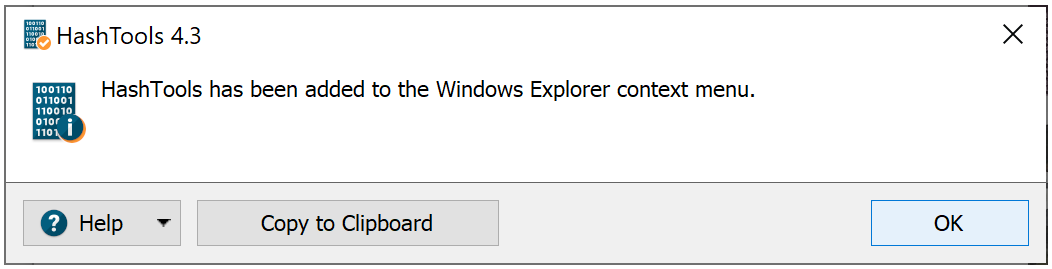
5. When the installer runs for the first time, it will show you a screen of the License Agreement. Accept the agreement and then click **Next**.



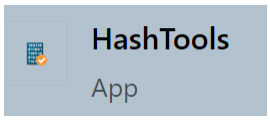
6. Click on the **Install** button when you are ready to do so.



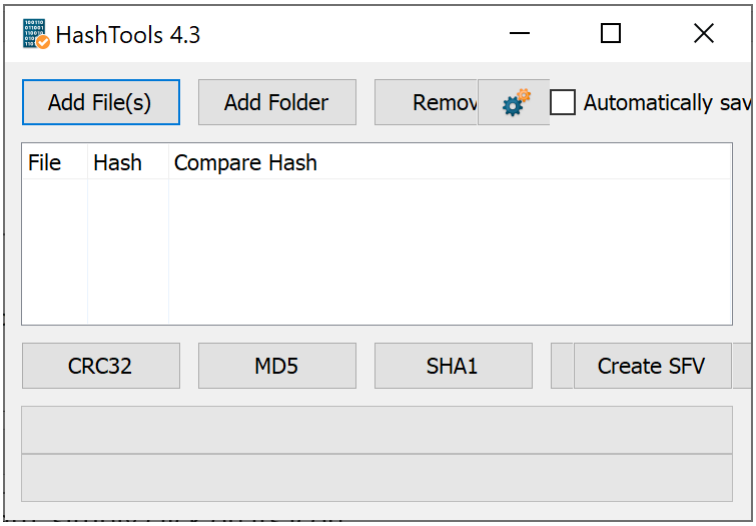
7. After the installation complete, a notification window will be shown.



8. If you want to run the installed program, simply click on its icon.
   Note: You could find the icon on your desktop screen or by searching it from the Windows search bar on your computer.



9. If you see the following screen, then your installation is successful. Well done and get ready for the next task.



REFLECTION QUESTIONS

1.	List four examples of hash algorithms.
2.	What is the issue with the MD5 algorithm?

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TASK 2: CHECKING THE INTEGRITY OF THE DOWNLOADED FILE

OBJECTIVE

To verify the integrity of the downloaded file by using a hash checking tool.

TASK DESCRIPTION

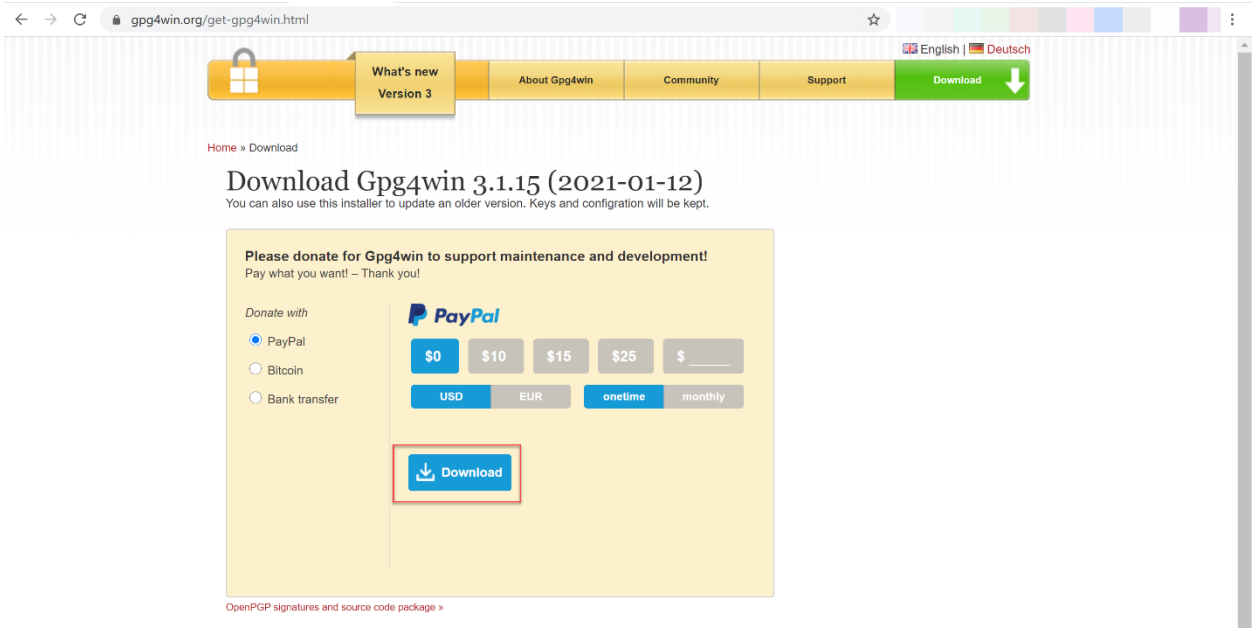
The student needs to download an encryption software known as Gpg4win. This software supports the cryptography standards such as OpenPGP and S/MIME(X.509). Before installing it, the student is required to check the integrity of the program file by using the tool downloaded in Task 1.

ESTIMATED TIME

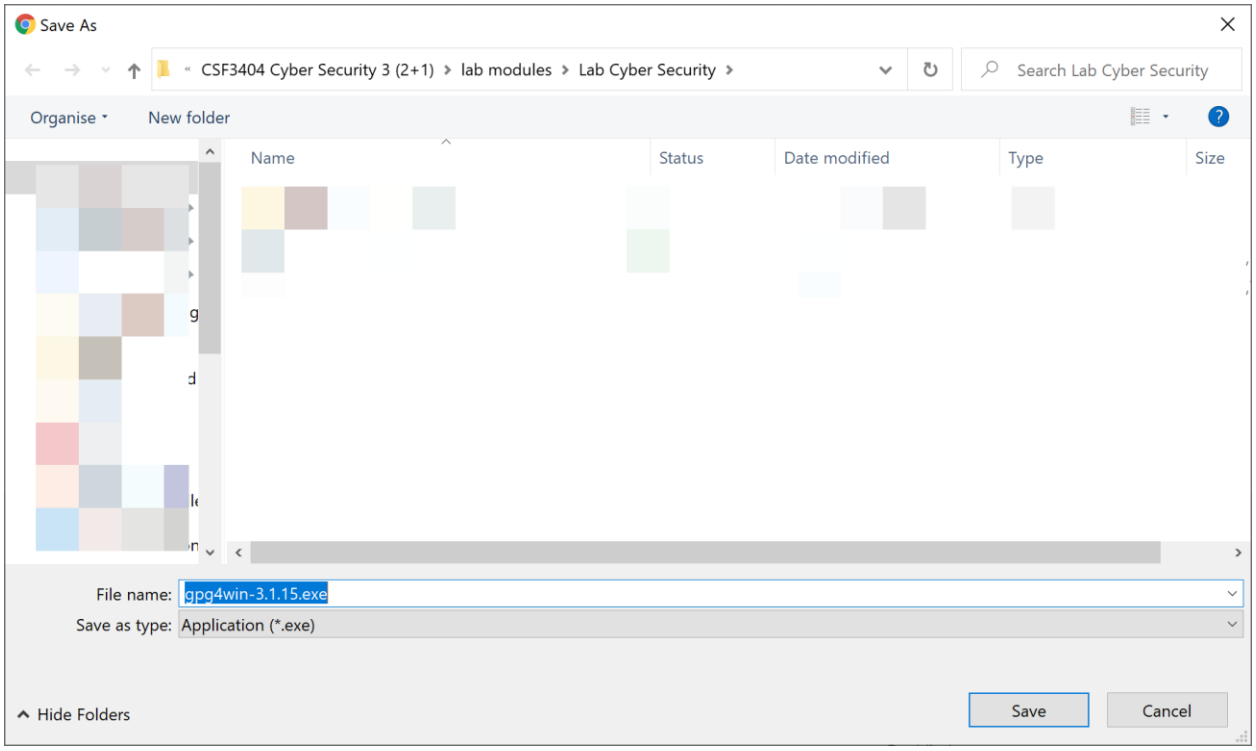
30 Minutes

STEPS:

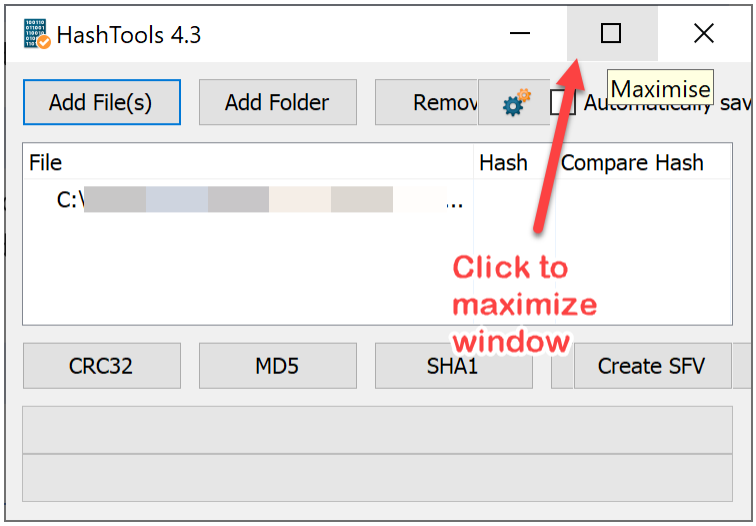
1. Type this URL https://www.gpg4win.org/get-gpg4win.html at your browser address bar and hit **Enter**. You will see a screen as below. If you plan to donate, you may choose any amount shown. However, for the simplicity of this task, just choose $0, then click **Download**.



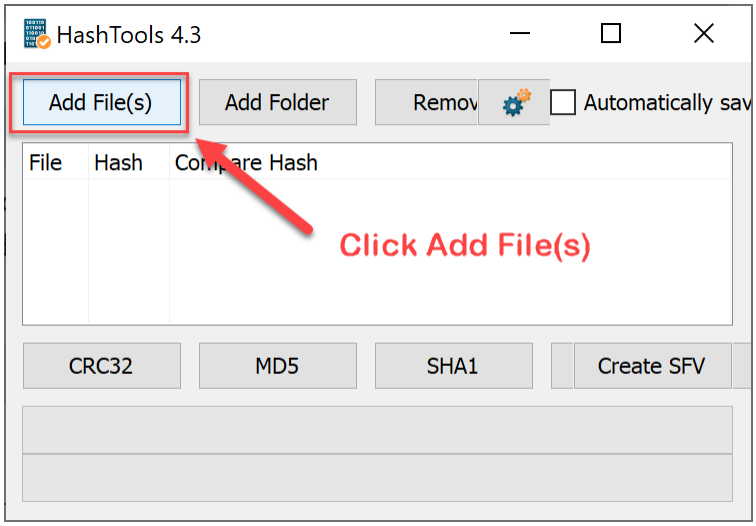
2. Now, save the installer at a suitable location.



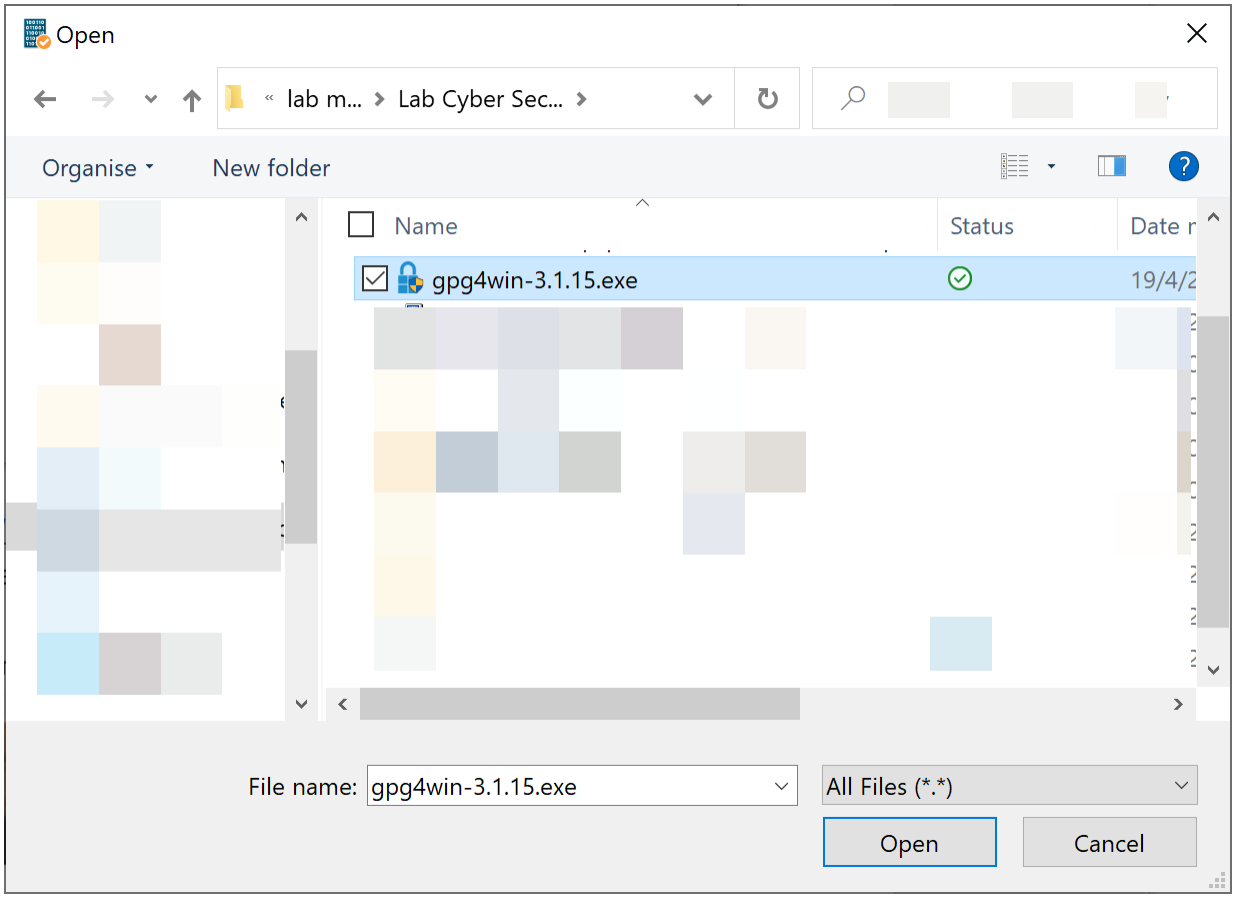
3. Wait until the download complete. **<u>Do not run the installer</u>** yet because we need to verify the checksum first. By checking the checksum (which refers to a value of the message digest of the installer), we can make sure that we have downloaded the verified version and not the version tempered by an attacker.
4. Run the HashTools that has been installed before. Click maximize windows to get a better view.



5. Then, click on **Add File(s)** button.



6. Select the installer program from the location you choose in Step 2.



7. Your selected program file will be shown on the HashTools windows. We are going to use the SHA256 hash function to get the hash value (message digest) of the installer. Click on the **SHA256** button.

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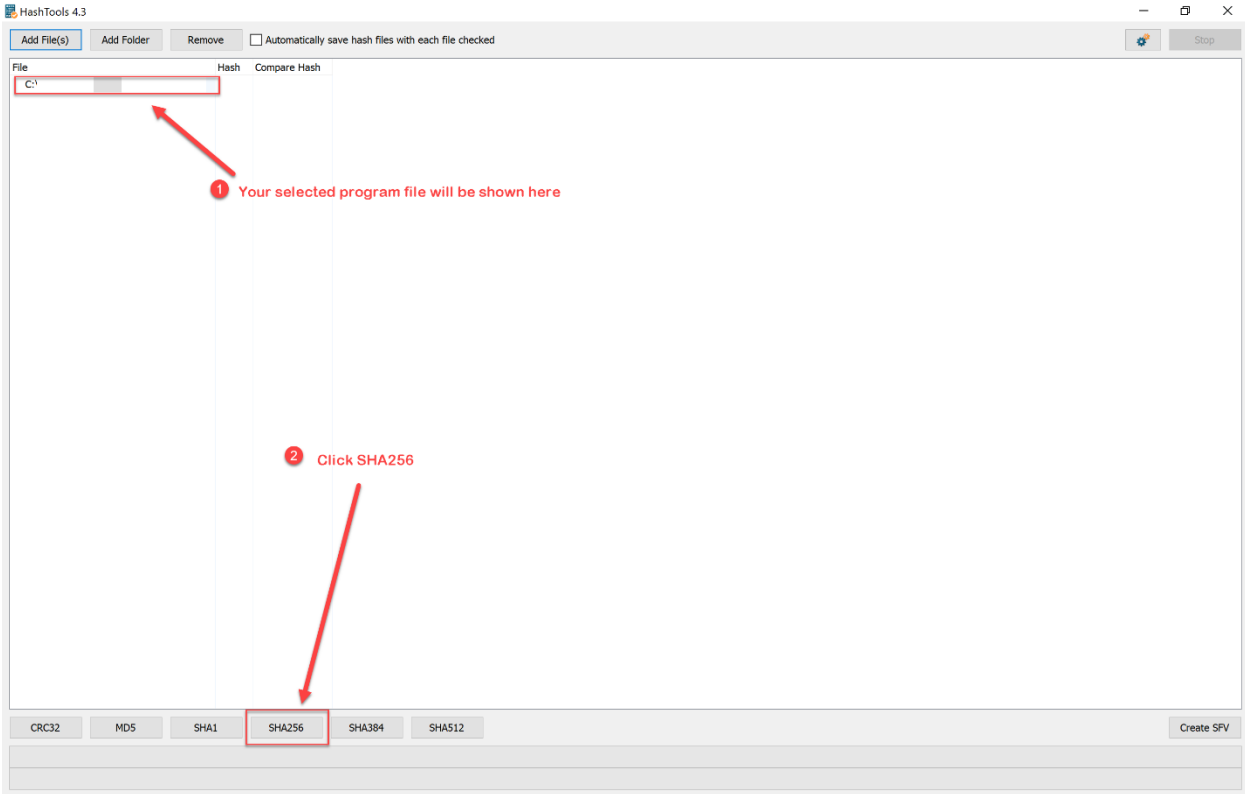
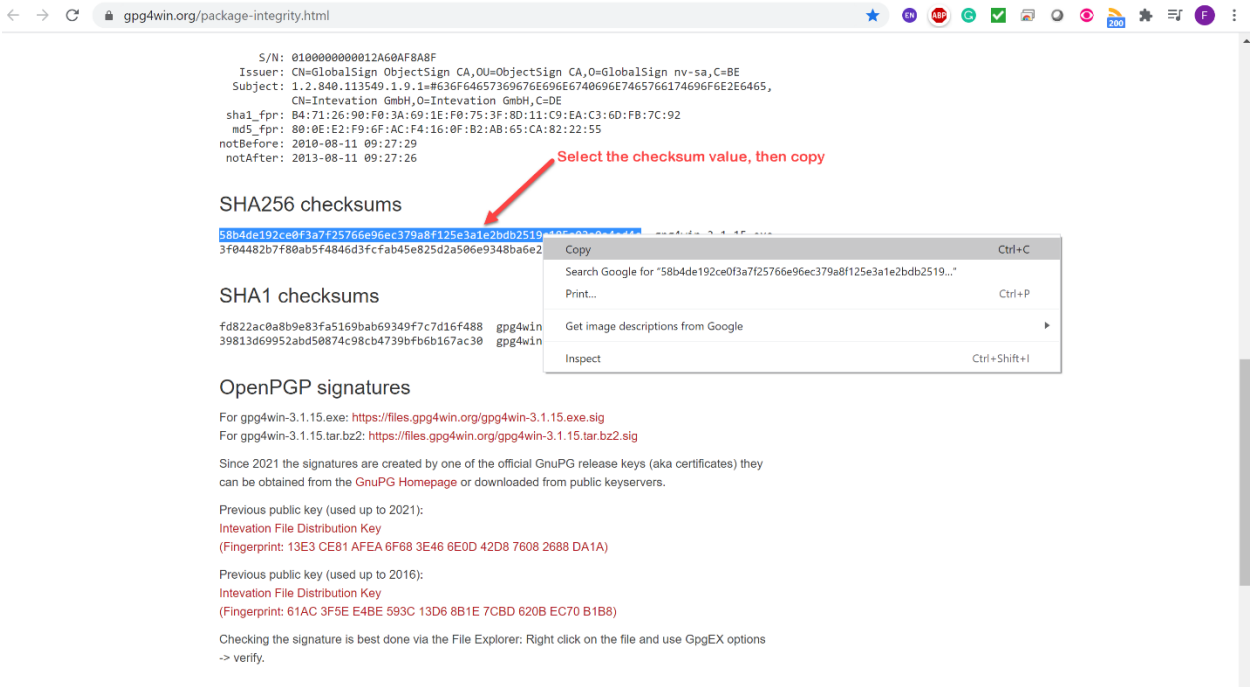


8. As a result, you will see the computed hash value at the column **Hash** on the HashTools window. Next, we need to retrieve the hash value from the gpg4win website.
9. Go to https://www.gpg4win.org/package-integrity.html, scroll down until you see the hash value located at the **SHA256 checksum** section. Select and copy the hash value for gpg4win-3.1.15.exe.



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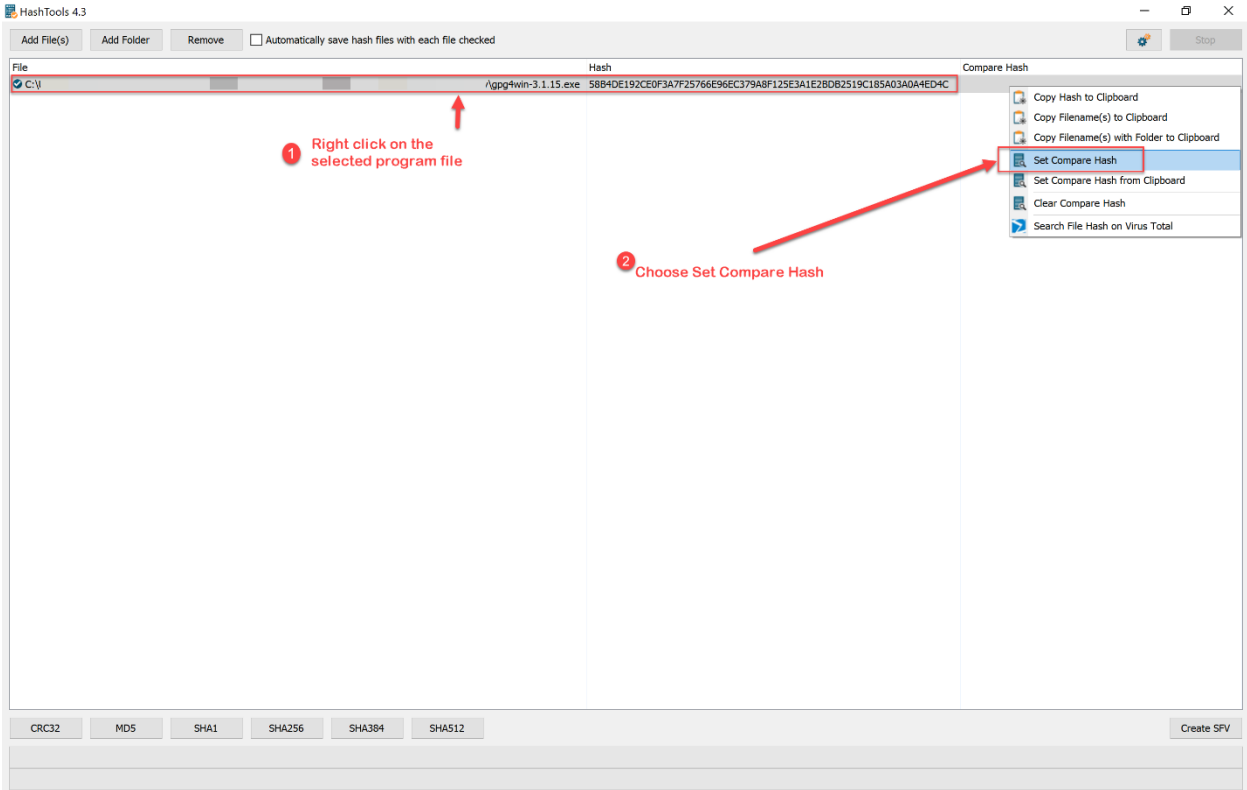
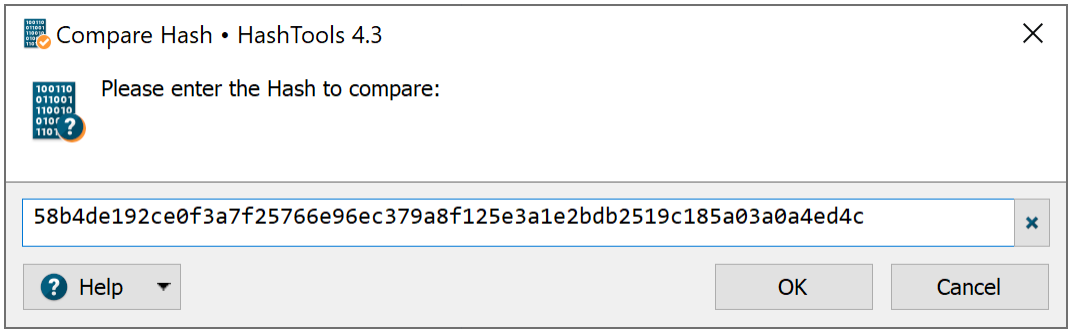
10. Now, go back to the HashTools screen. Follow the steps as shown in the screenshots below:



11. Paste the hash value that you have copied in Step 9. Click **OK**.



12. If the values are the same, then you will see a light green colour highlighted with a tick mark on the left. This also means we have downloaded the verified version of the installer software and nothing for us to worry about.

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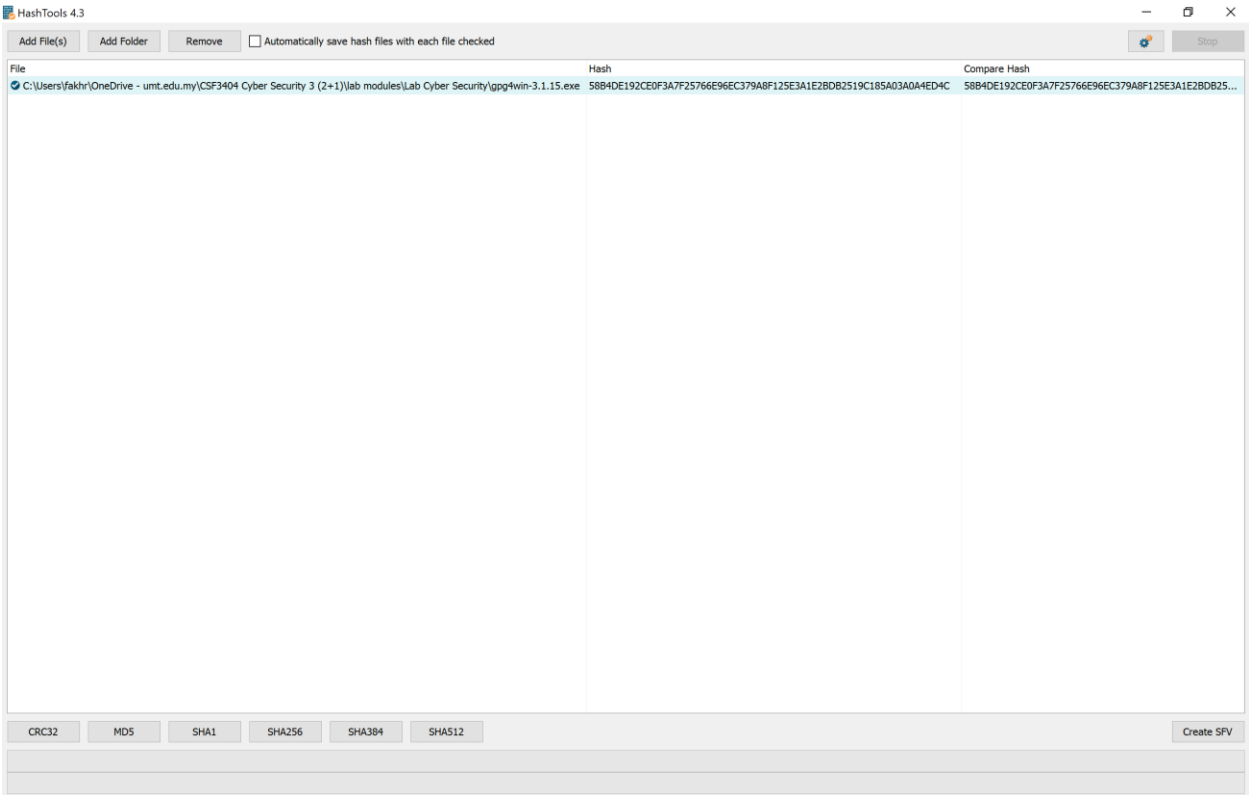

13. Otherwise, if the hash values are different, you will see a screen similar as follows:
    Note: Try to copy a different hash value to get a similar result as shown on the screenshot below.

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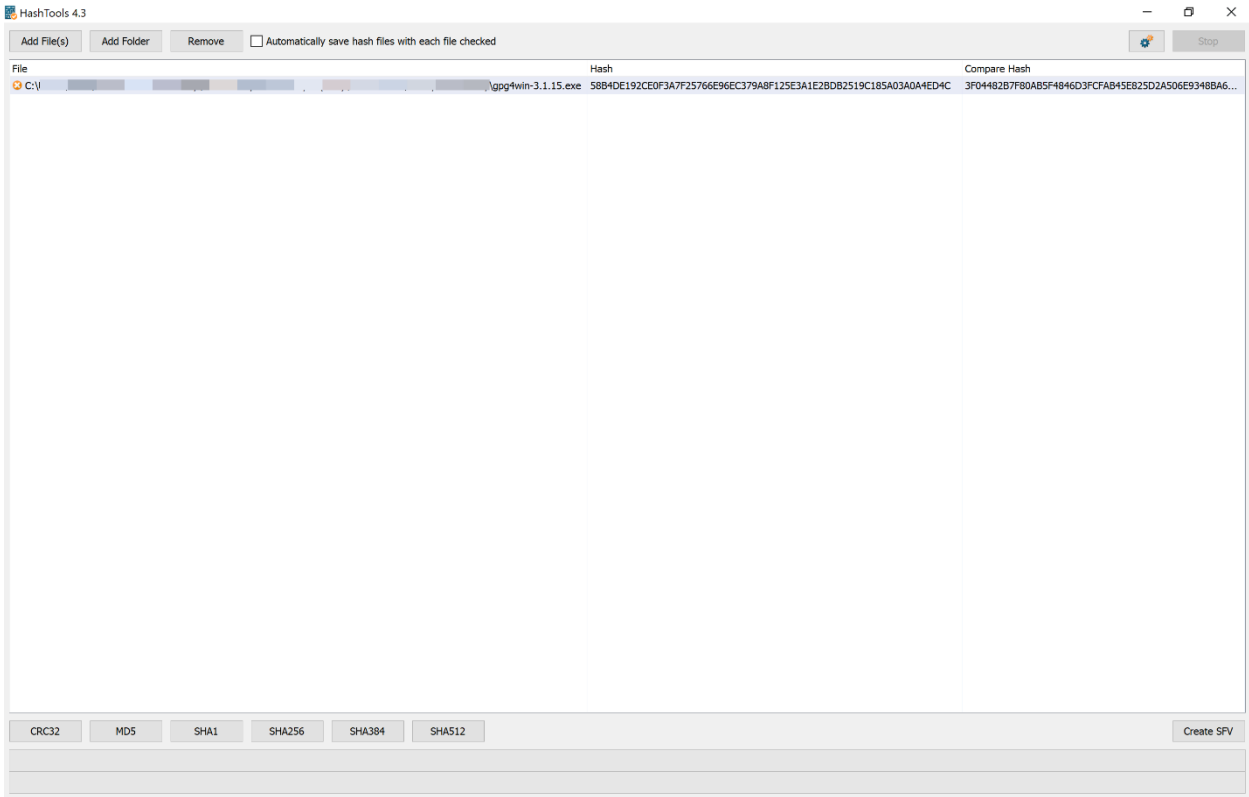

14. Print screen the result of these activities and put it into your lab report.

15. Now, we are ready for the encryption tool installation in Task 3.

REFLECTION QUESTIONS

1. Describe the functionality of hashing encryption compared to symmetric and asymmetric encryption.

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TASK 3: INSTALLATION OF ENCRYPTION TOOL

OBJECTIVE

To install and set up the encryption tool.

TASK DESCRIPTION

For this task, the student will install the encryption tools using the installer downloaded in Task 2. This tool later will be used to experiment with the encryption and decryption process.

ESTIMATED TIME

30 Minutes

STEPS:

1. To begin the installation, go to the location of **gpg4win** installer. Then, double click on it.
2. You will see a welcome screen as following, then click **Next**.

3. Make sure **Kleopatra** is selected as one of the components to be installed.

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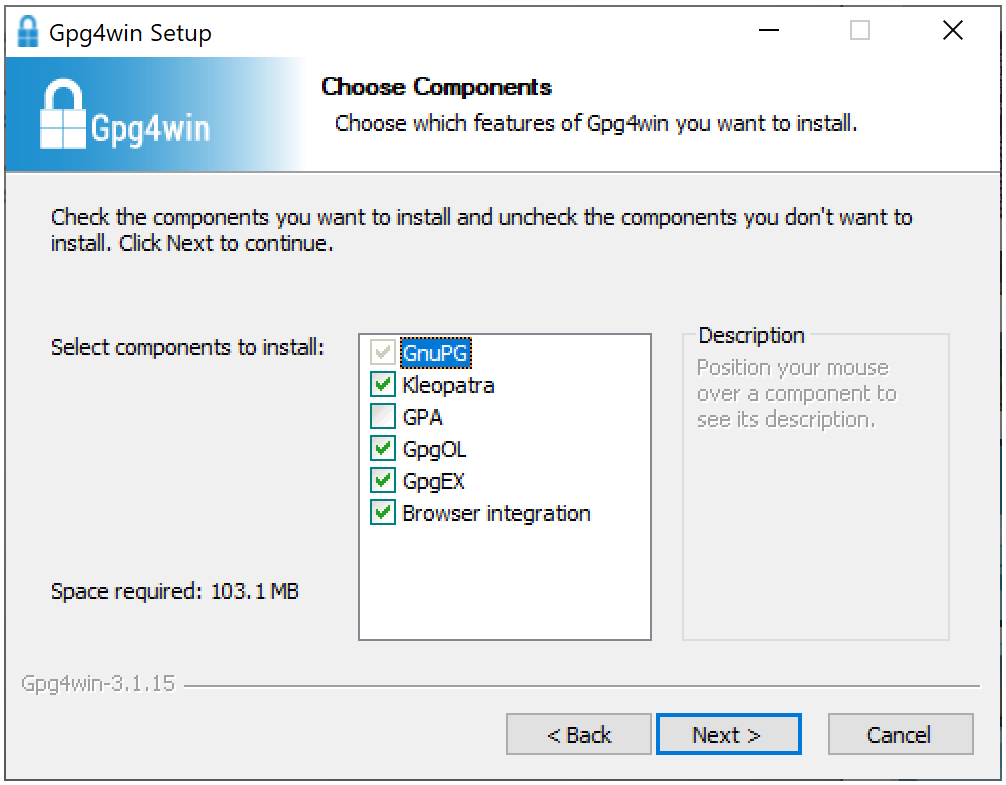
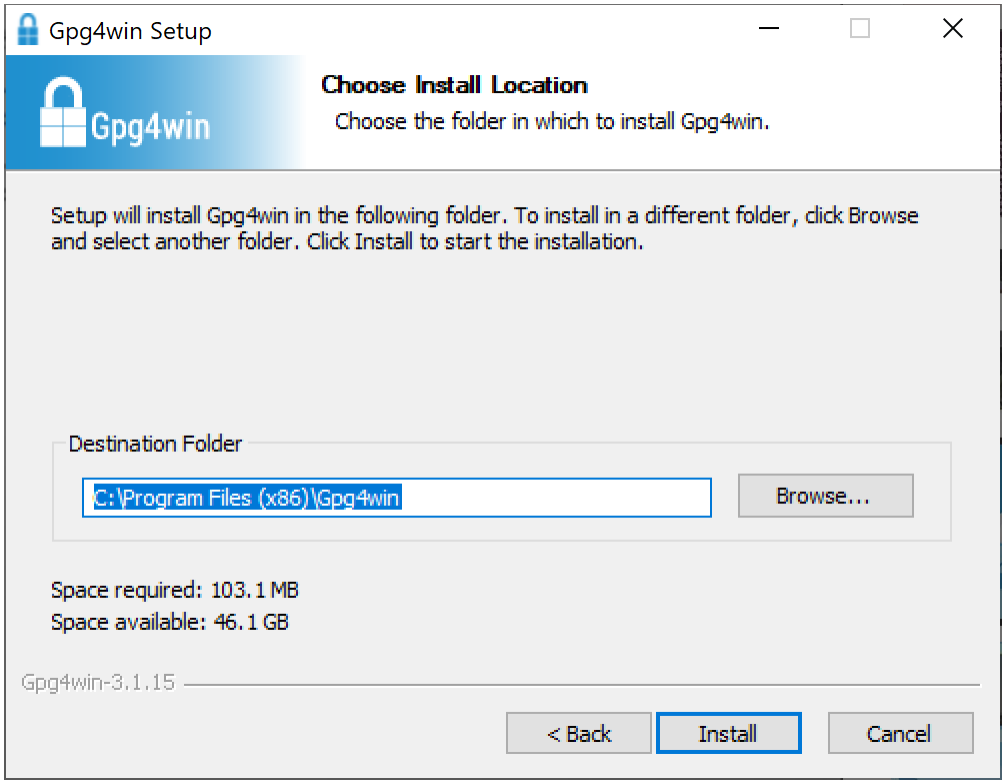


4. Finally, click on the **Install** button. Wait until the installation finish.



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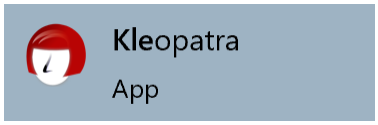
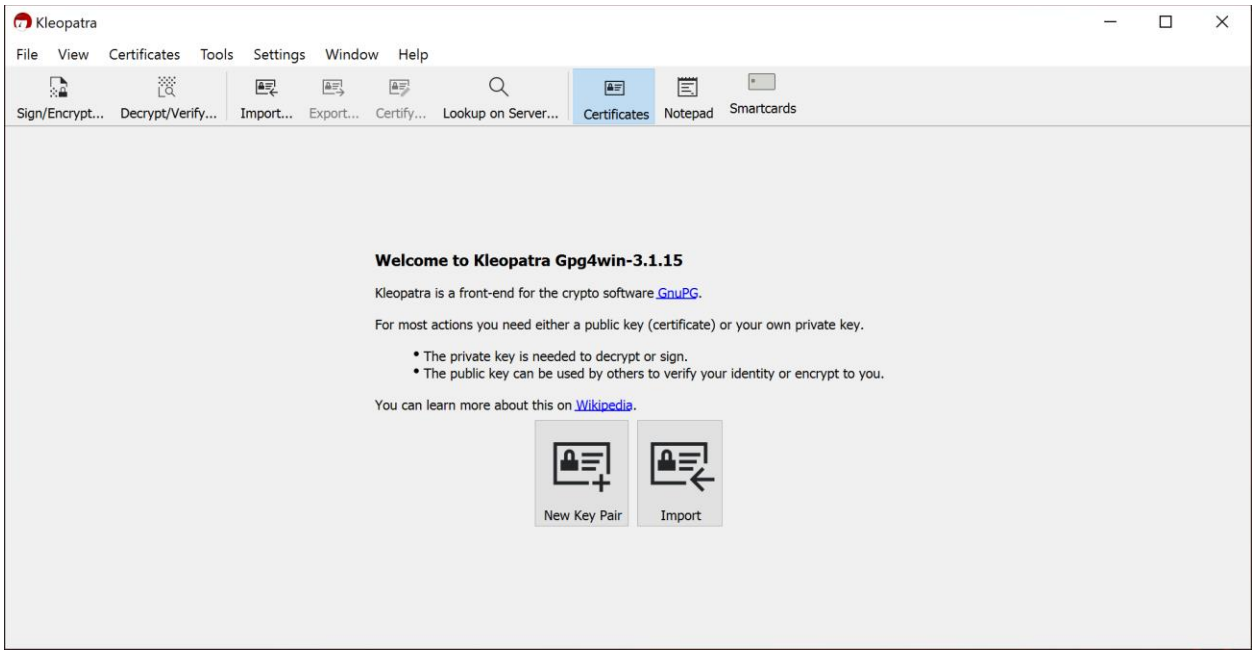
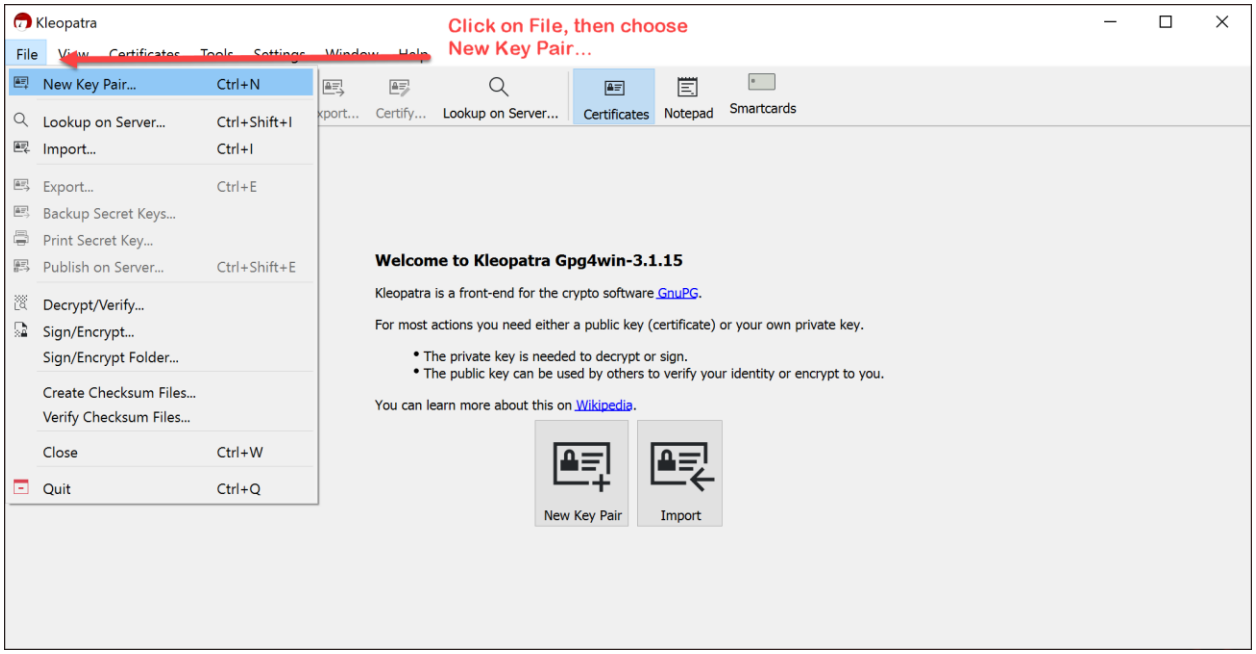
5. After the installation complete, run the Kleopatra program by double-clicking the icon



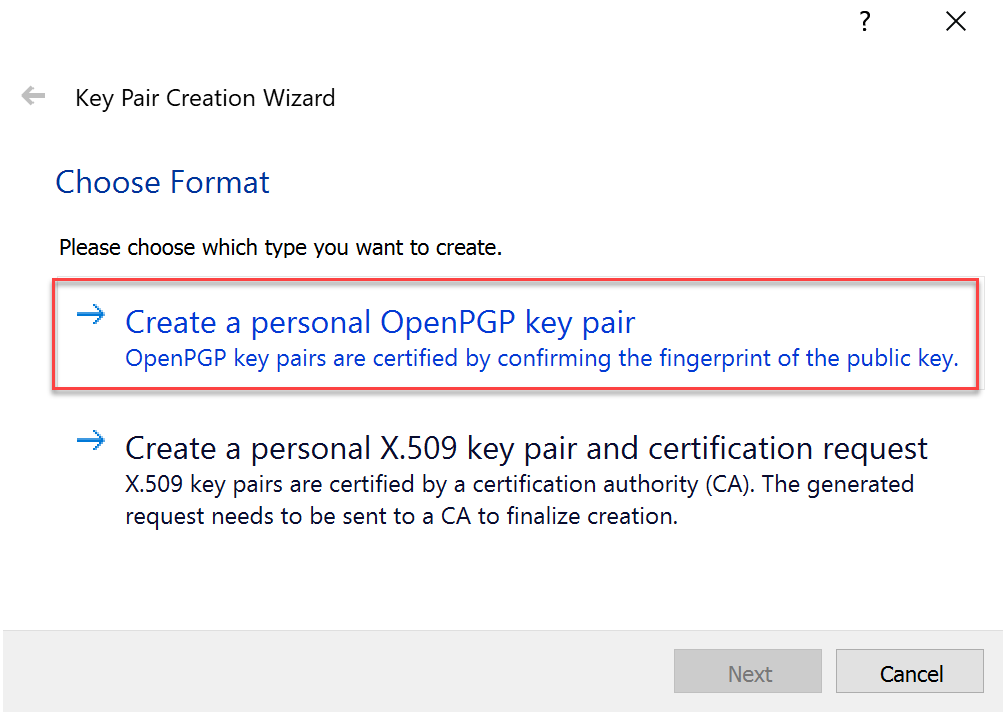
6. You will see the first screen of Kleopatra as follows:



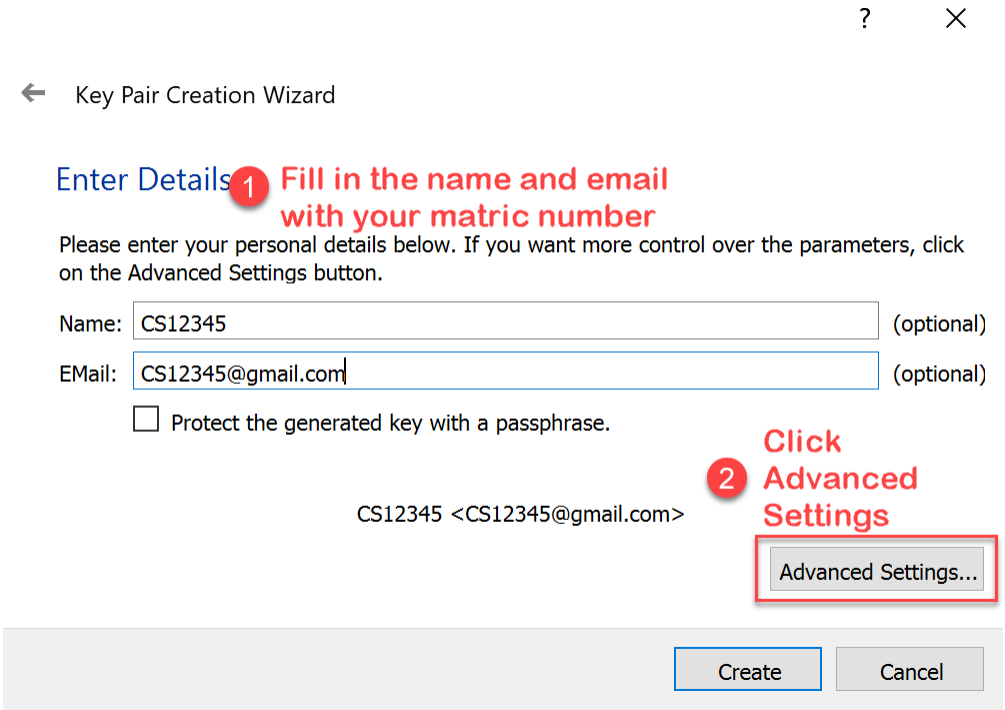
7. Next, we are going to get our public and private key. These keys will be generated by the gpg module that we have installed earlier.
8. To do that, follow the steps shown in the screenshots below:



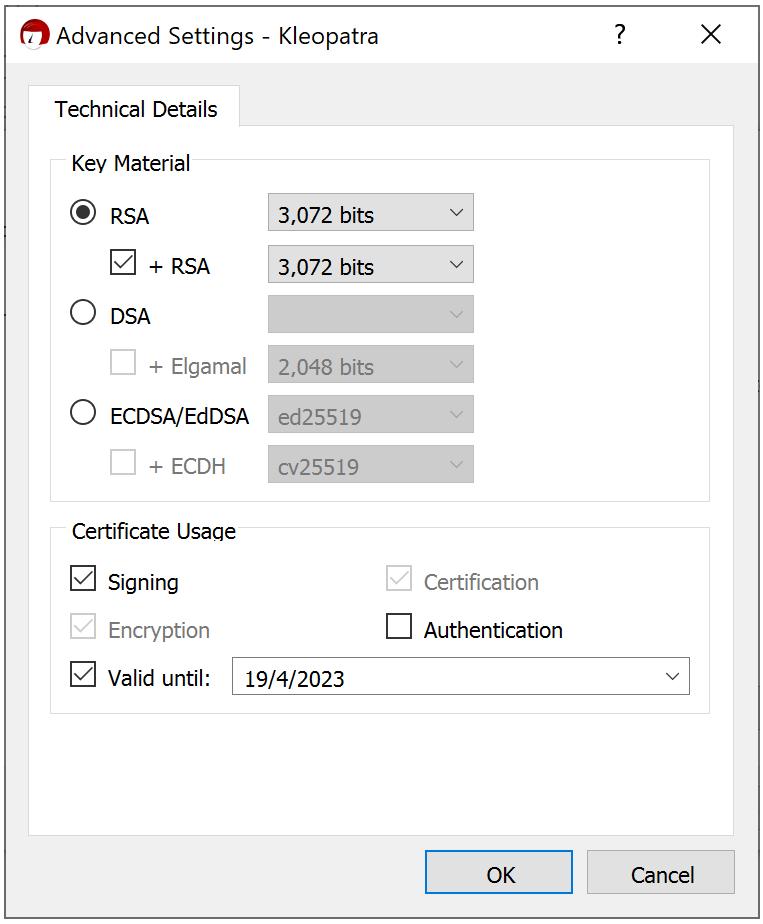
9. Now, we are going to choose the format for our key pair. Choose **OpenPGP key pair**.



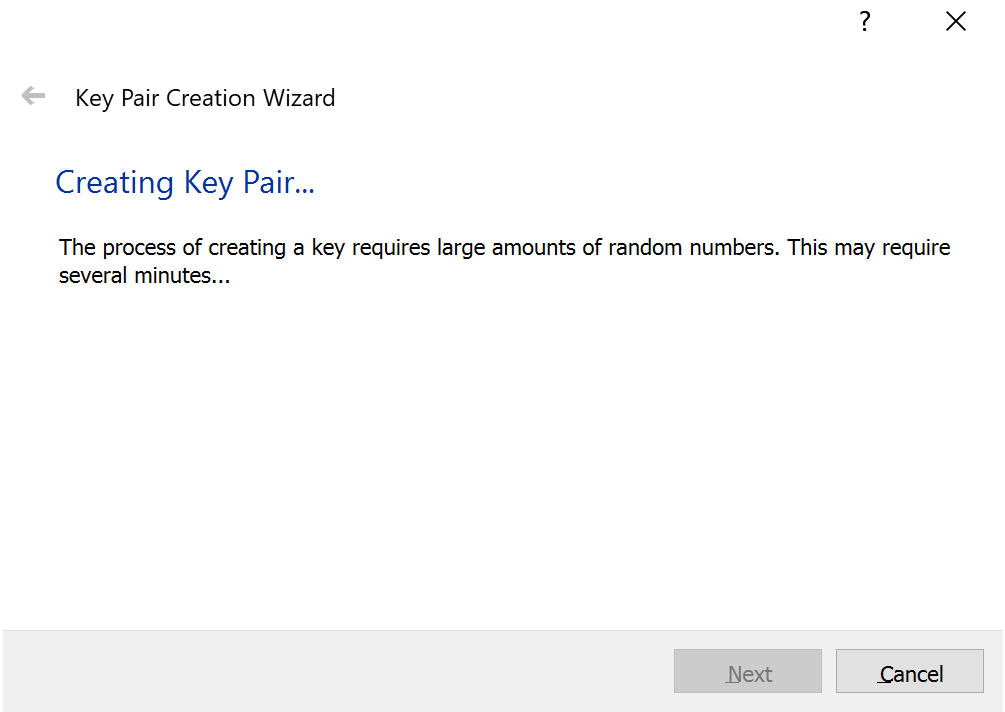
10. Fill the form with your matric number and email. Then, click **Advanced Settings**.



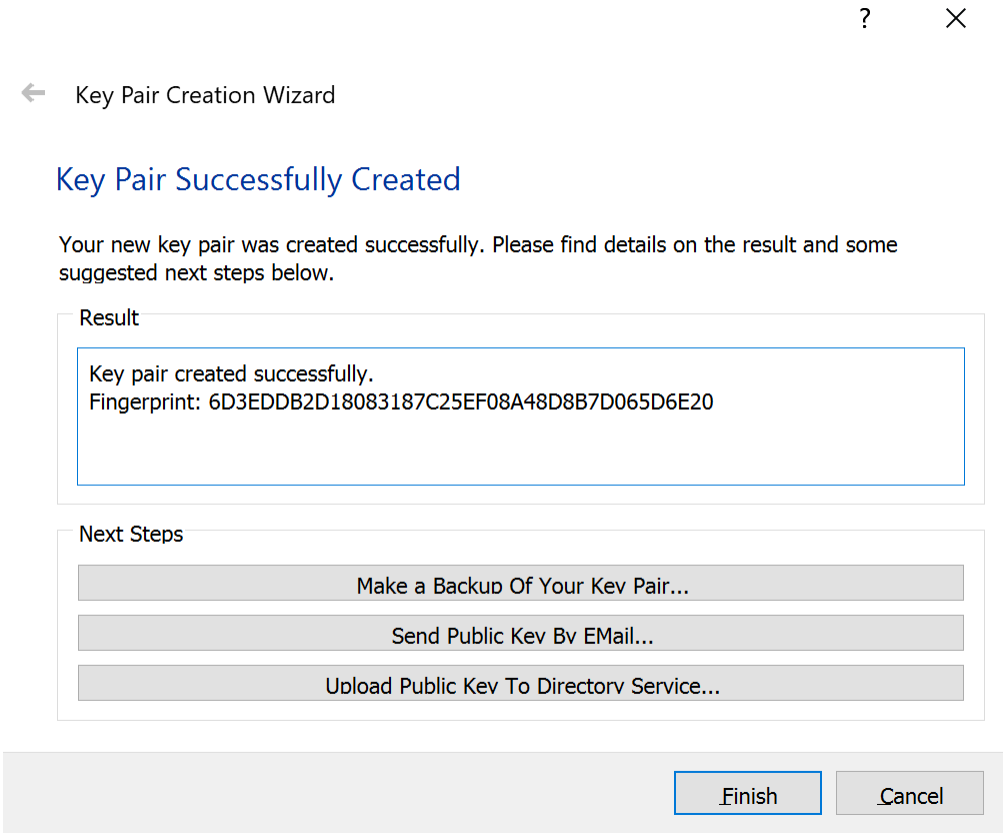
11. At the **Advanced Settings** screen, we can set the size of our keys. We are going to choose 3072 bits and using the RSA algorithm. Click **OK**.



12. This will take us back to the **Key Pair Creation Wizard** screen, then click **Create**.
13. Wait until the key generation process complete.

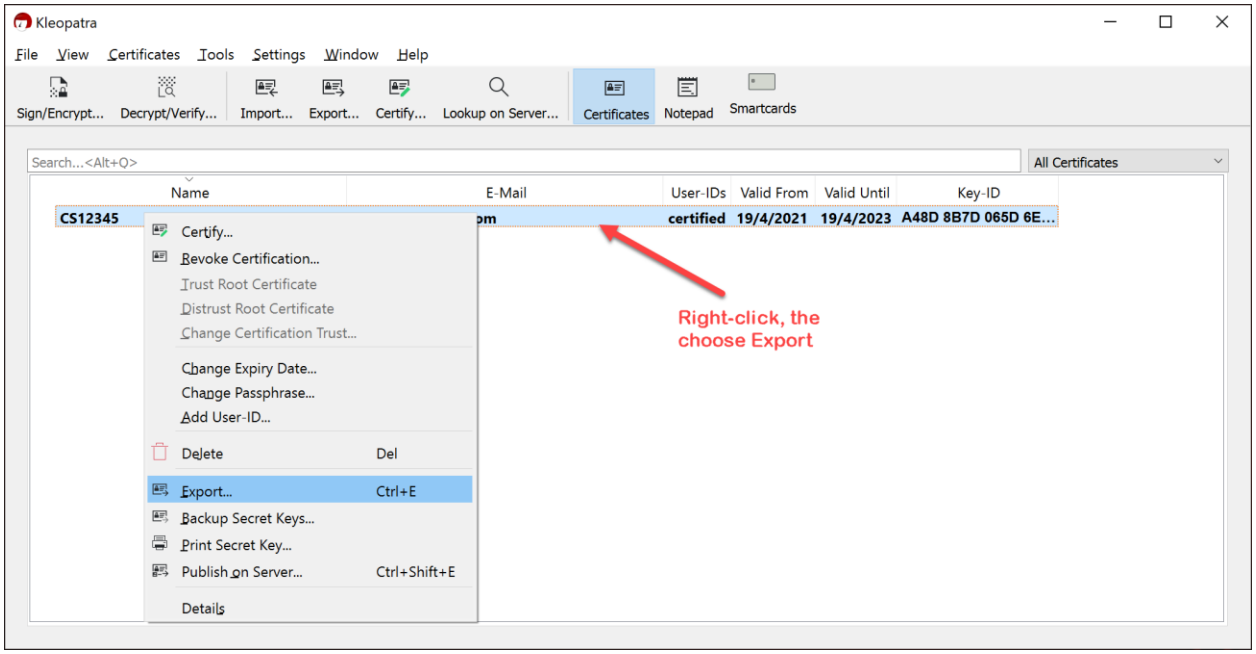


14. Once the key pair is ready, a window below will appear. Click **Finish** to close the window.

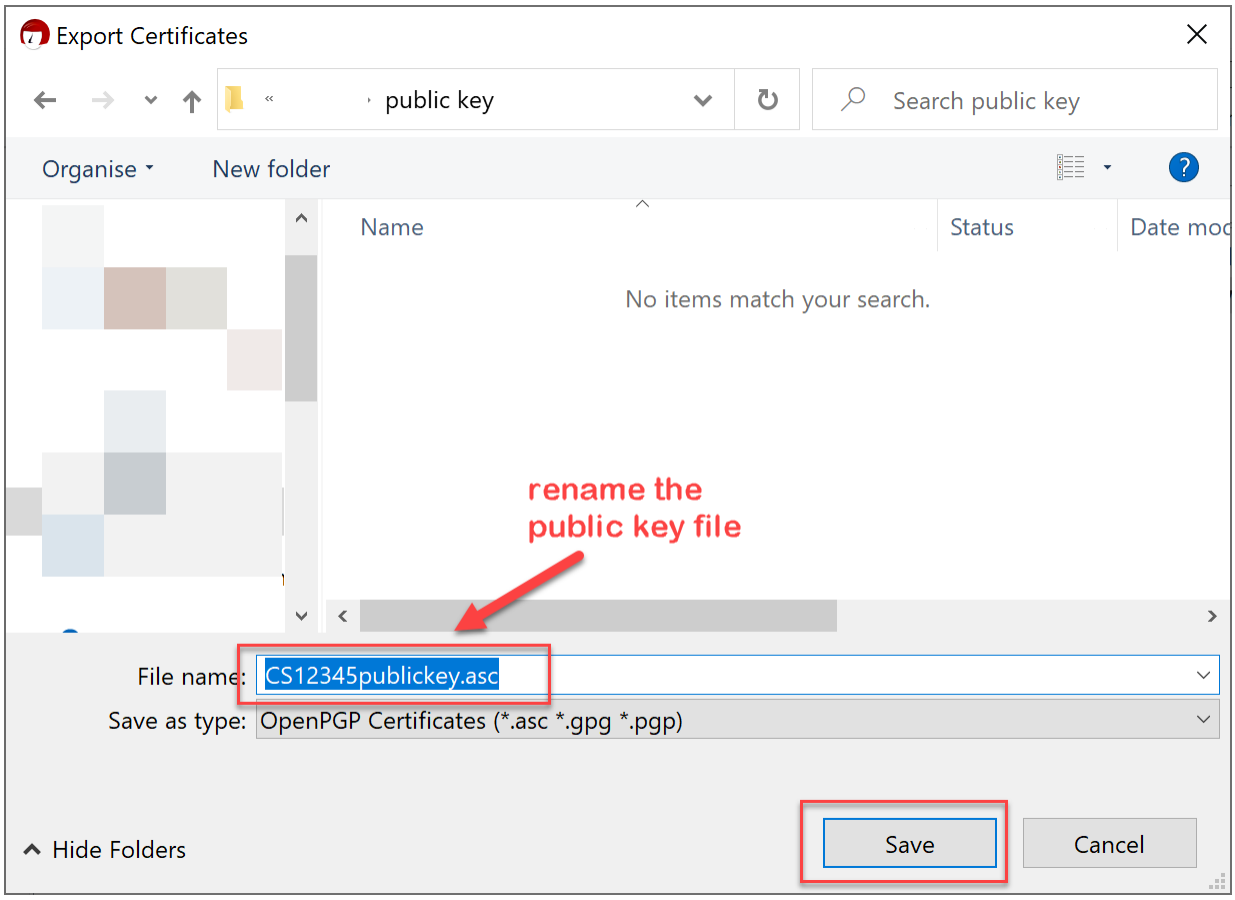


15. Next, we are going to export our public key to a file so that it can be shared with others. Follow the step on the following screenshot:

`



16. Re-name the public key using this format **[YourMatricNumber]publickey.asc**. Make sure you take note of the location where you keep the public key file.



17. We can use Notepad as an editor to view our public key file. You can do that by right-clicking on the file name, then choose Notepad.

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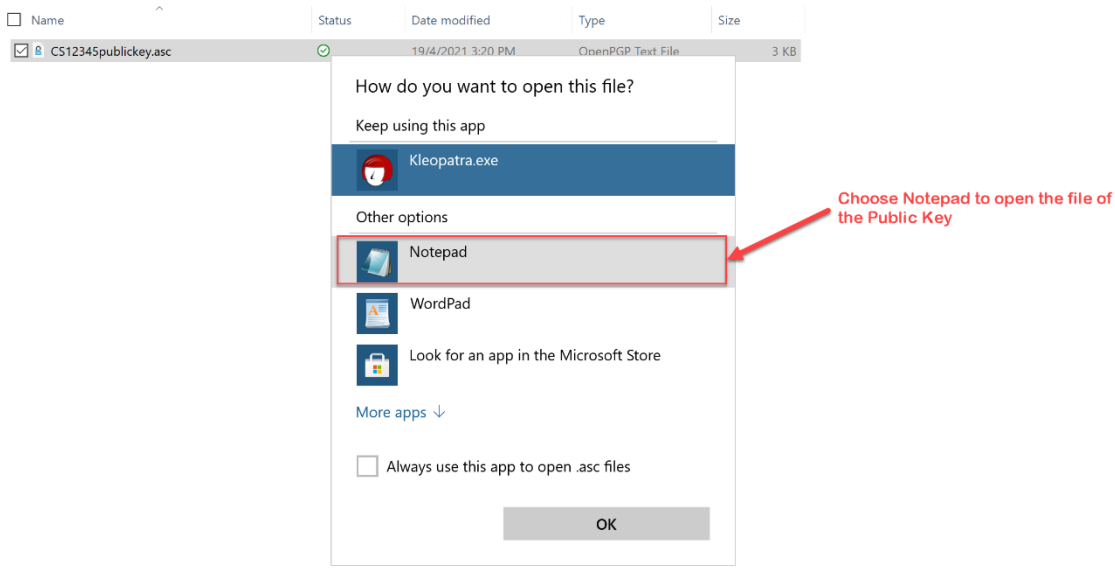

18. Take a screenshot of the content of your public key file and put it into your lab report. Example of a public key shown on the screenshot below:

`

CS12345publickey.asc - Notepad

File Edit Format View Help


```
-----BEGIN PGP PUBLIC KEY BLOCK-----

mQGNBGB9LgQBDADe8WcsuqiEFVsIndwFqknPCSY5rN2de3tD6NN/dAjULW8KixpU
nndULjQsi8udRB8ujz0naIq9I4K7EWIIhNp4d/Zduf/MugyUm1Xo8OKIulV1yeHB
EhUWopdV/R9MFkoZqHzBkM5WJYJFQbN7LiBKYpRqDWG9UJh3aDa97VcUky58YCaQ
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ZQYKn/7wqvK/iYEg/Imka1tEFwK2UiR5nBzU62XqriFO6EdCus7wxI2cEdZDHlEY
R7VJr/2UXFfq2kPAnPztm2YmwDFk84Qc5N4+AWmnk+m1GzRn8jOCCkjRsfHDEFoJ
l3Ica8N0pZeK6qutAf9Ncc51fV5i3KGDwwIEvAleH9J/pfBIY03eT/4nghAi0ZJo
awb4/KOccxHUinyQuu+qPEJ8RXHwXS9CCbeUR9Ebwz2pHVNqc3dW7zlbzoEpxSC7
4zXJ20WthPVS/RFqrliFOP1xNr8/idCwfPgkJxPx0Yb/e7cHTVQHY85xzFcB70an
gYKdMvbGZ82ekM9zJm1SeENK2aim/9nOYbrkpmUdmVpJm40Quv0+2Hw3NpChBTY4
pU4o/xsr+eggnsPceQSxaNrwsQ==
=tNZb
-----END PGP PUBLIC KEY BLOCK-----
```


19. Keep the public key file in a safe place. We will use it in the next task.

`

REFLECTION QUESTIONS

1. What is the meaning of GPG?
2. Using your own words, explain the difference Between PGP and GnuPG?

`

TASK 4: SHARING A PUBLIC KEY AND ENCRYPTING A FILE

OBJECTIVE

To share and use the public key for encryption.

TASK DESCRIPTION

The student is required to share their public key with his/her friend through email communication. Next, the student will encrypt a file with a secret message by using his/her friend's public key, then send it through email.

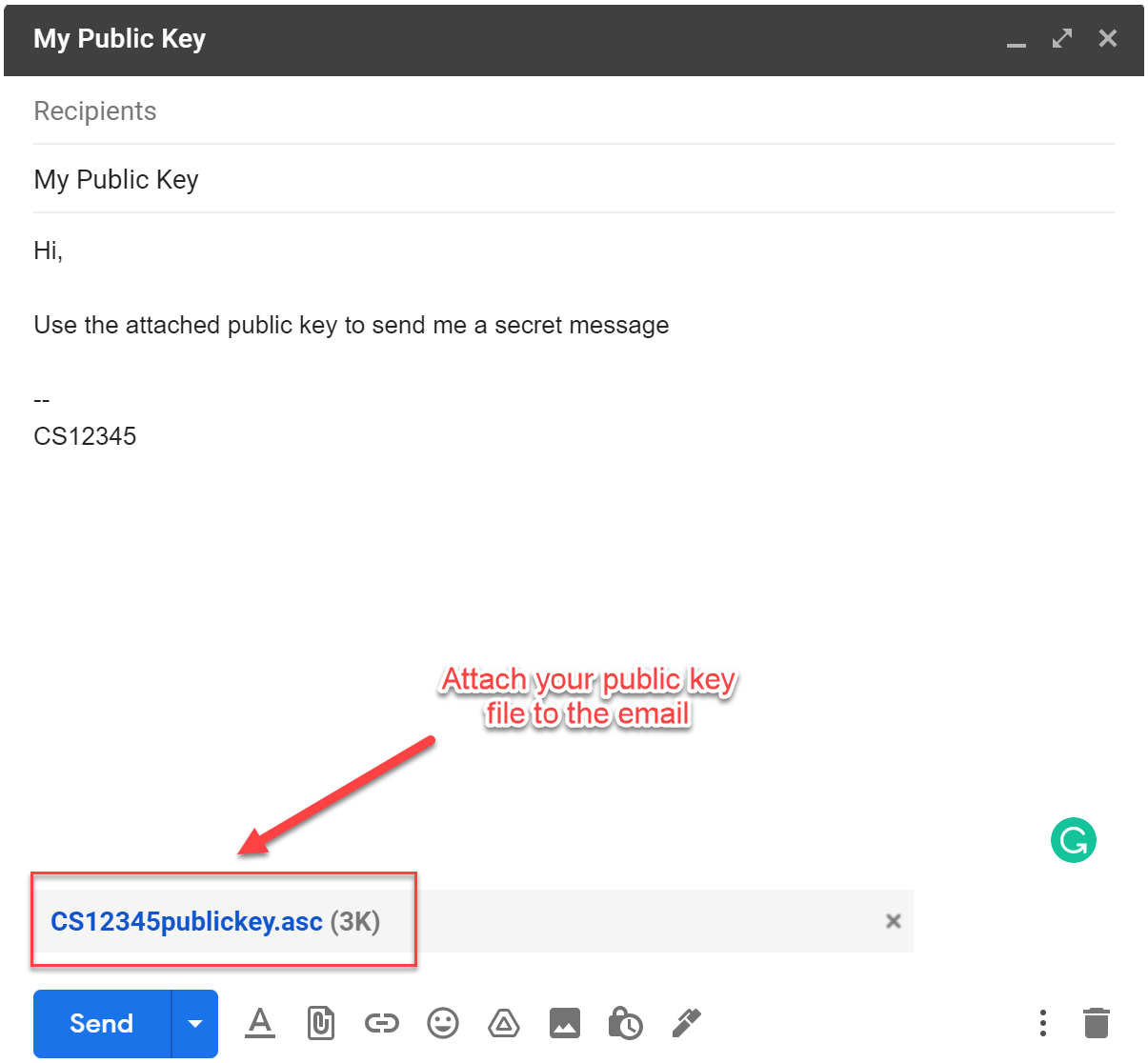
ESTIMATED TIME

60 Minutes

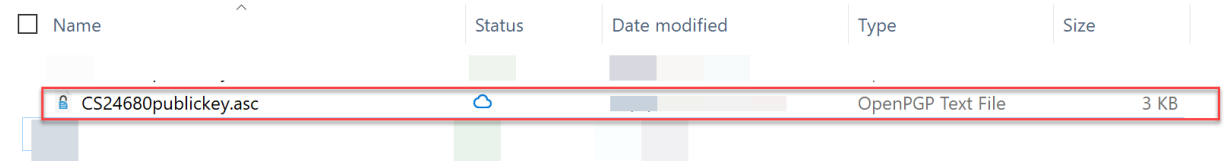
STEPS:

1. For this task, we are going to work in pair. We will begin by sending an email to our friend along with the public key attached. Open your email editor, write a simple message, then attach the public key file that you have created in the previous task.

`

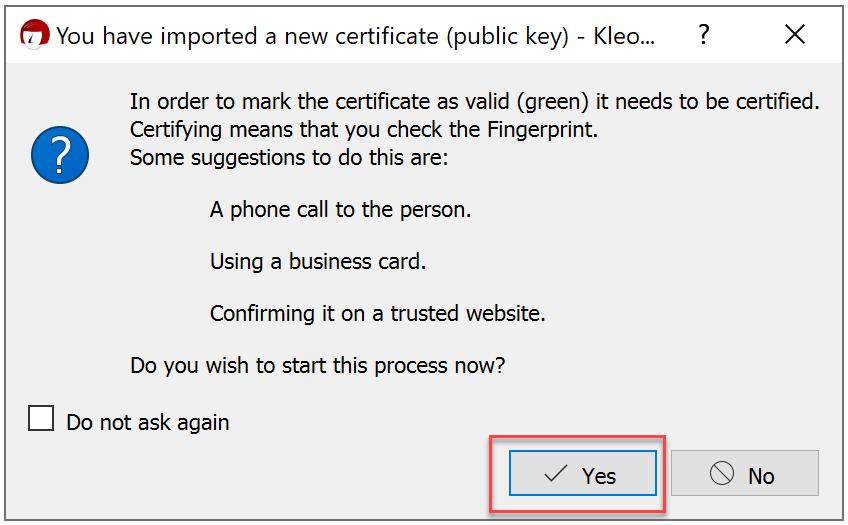


2. After receiving a public key from your friend, download the key file into a safe place. **Double click** on the file so that it can be imported and saved by Kleopatra.

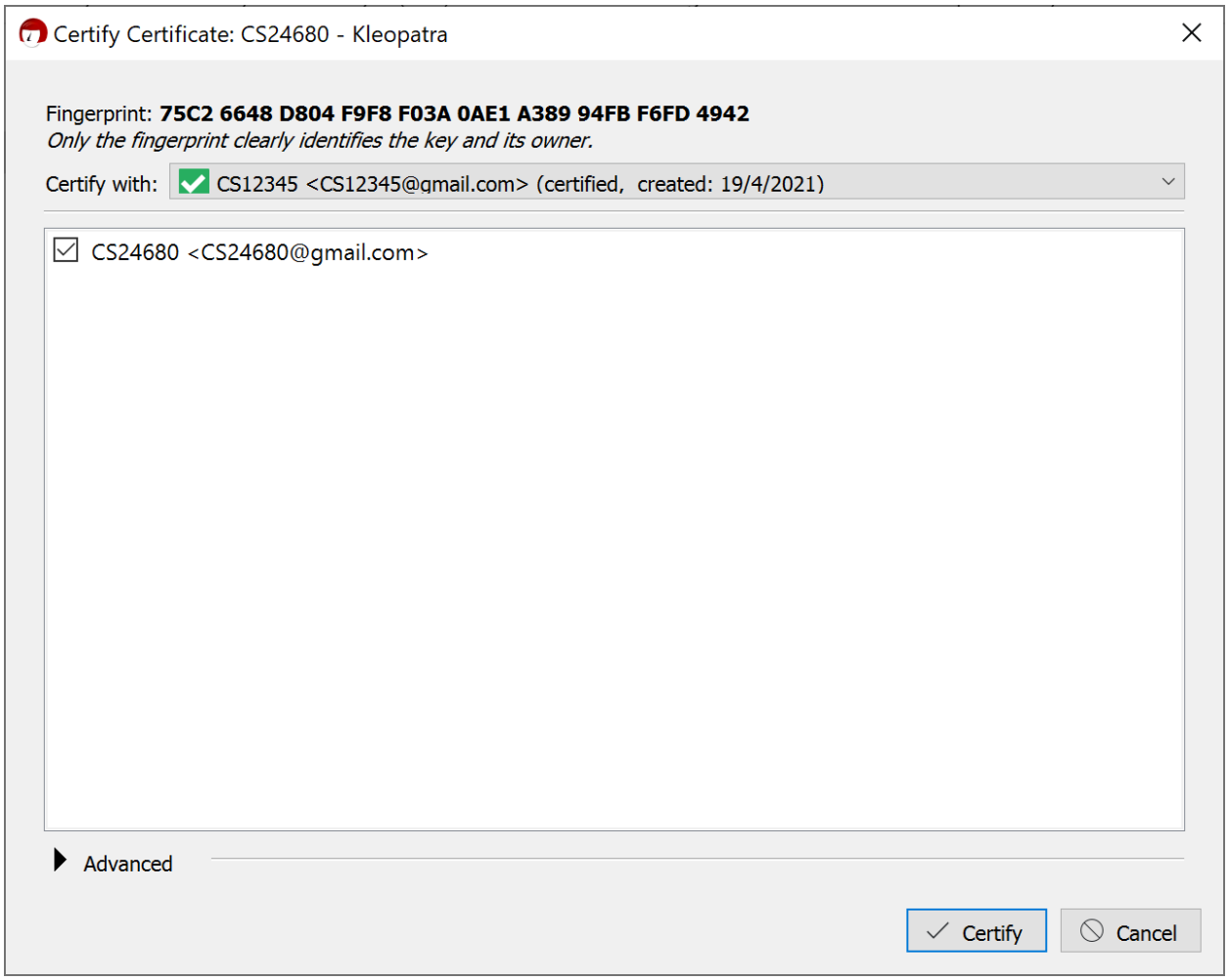


3. Before proceed, Keoplatra will ask you to check the fingerprint. Simply click **Yes**.

`



4. Then, click **Certify**.

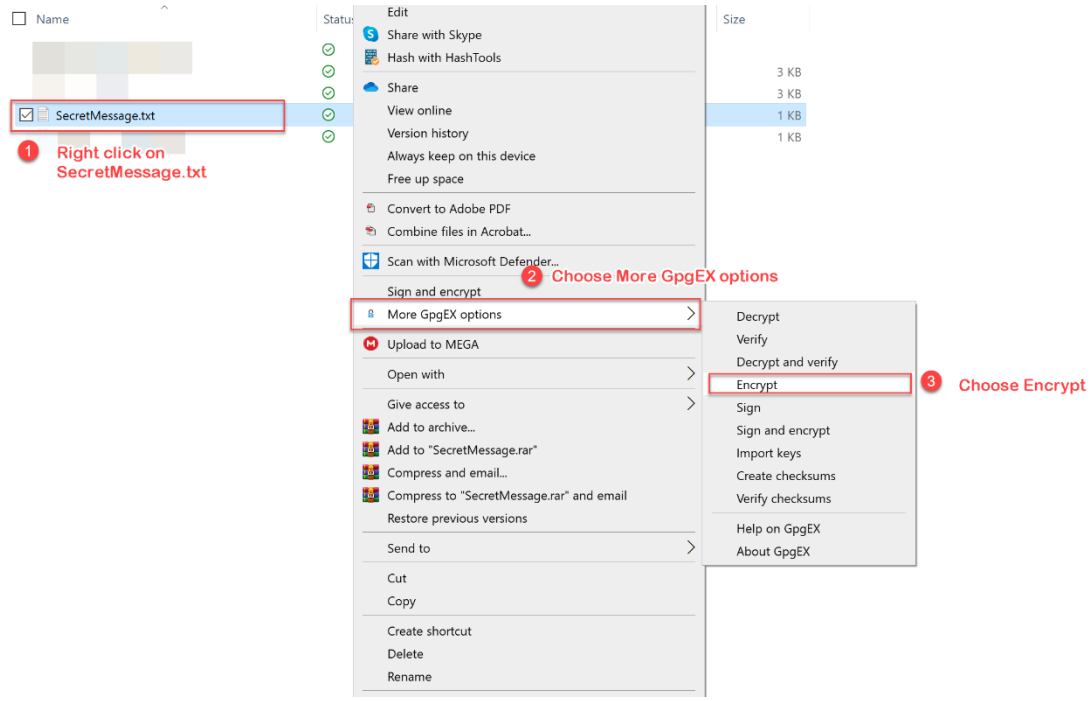


5. At this moment, your friend's public key is ready to be used for encryption.
6. Next, we are creating a text file with a secret message. Open a Notepad then type this phrase "**This is a secret message from [Your Matric Number].**". Save the file as

`

SecretMessage.txt. Take a screenshot of the content of the file and put it into your lab report.

7. Now right, click on the **SecretMessage.txt** and follow the steps below:



8. Select the public key that belongs to our friend.

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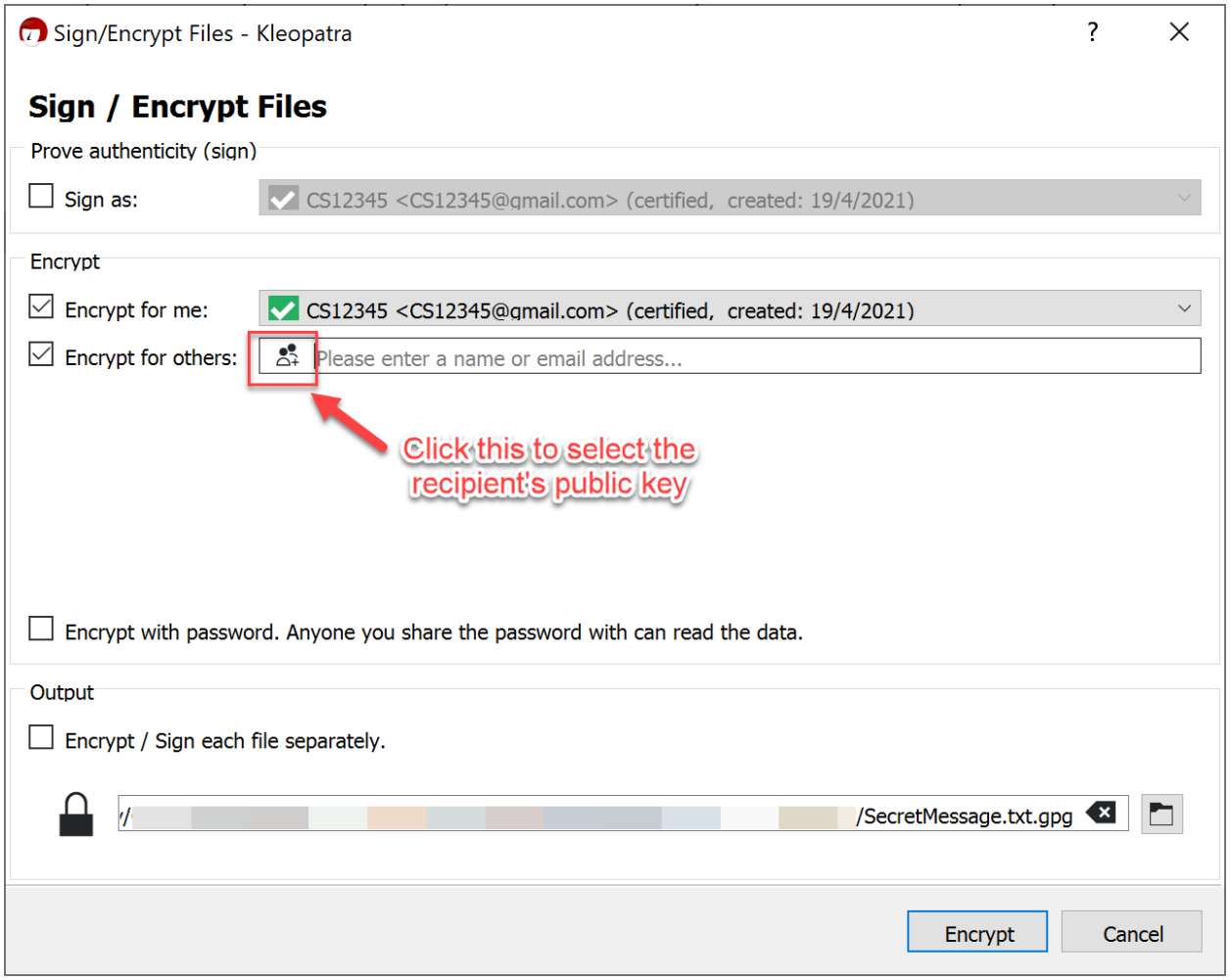
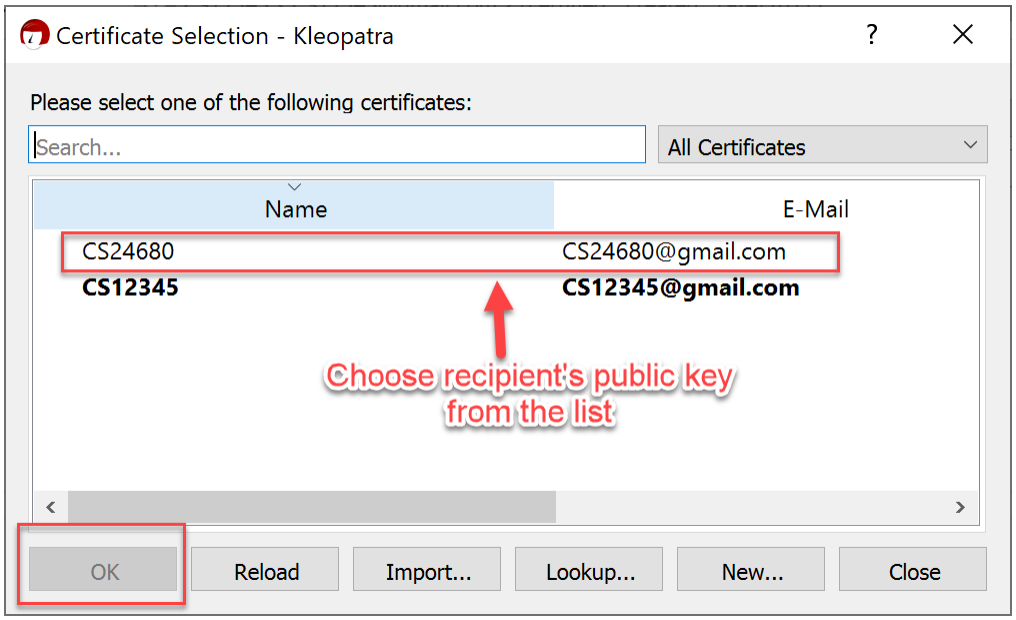
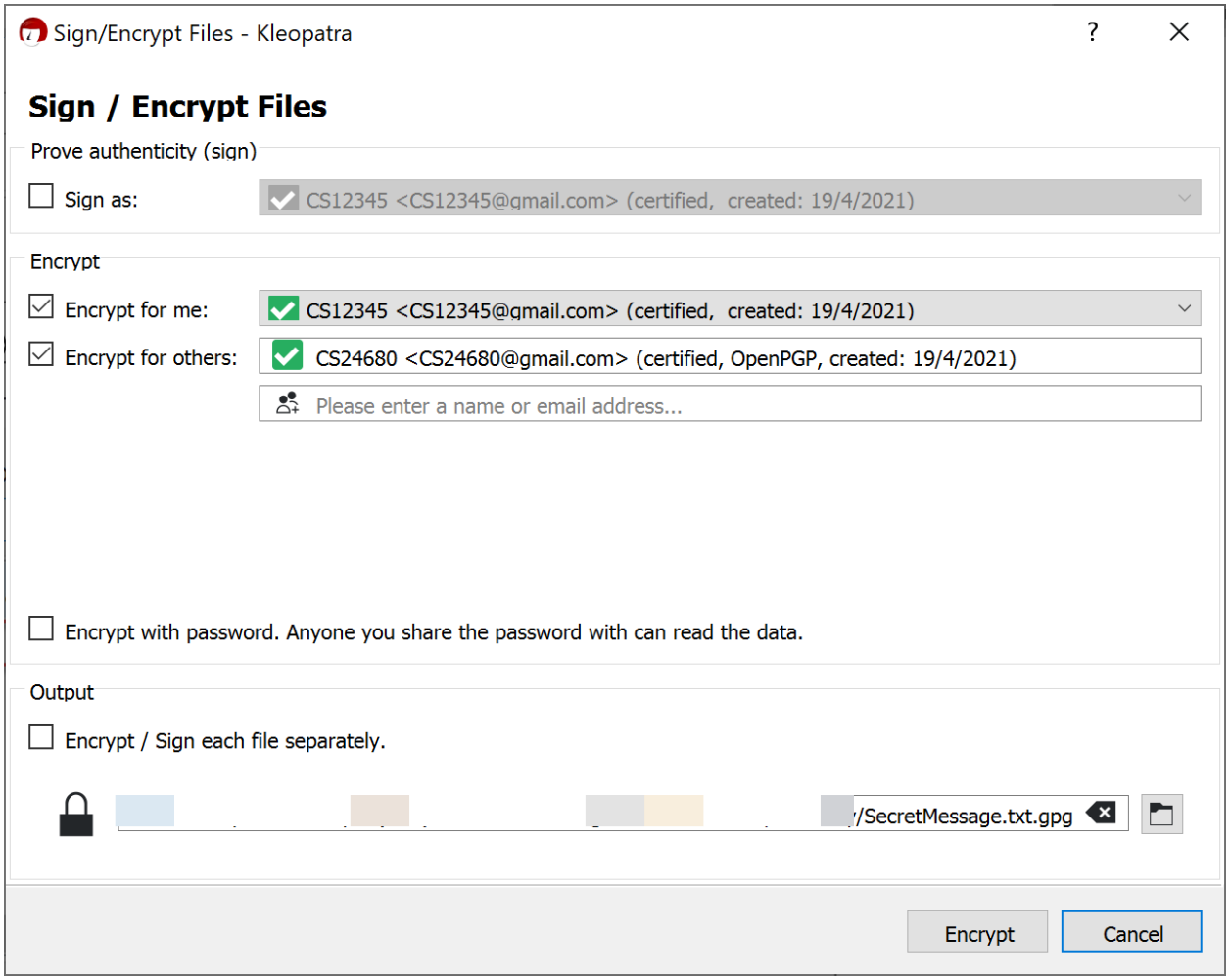


9. Choose the public key from the list, then click **OK**.



10. Make sure the configuration looks similar to this before clicking on the **Encrypt** button.



11. After you click the Encrypt button on the above step, a message from Kleopatra will be shown:

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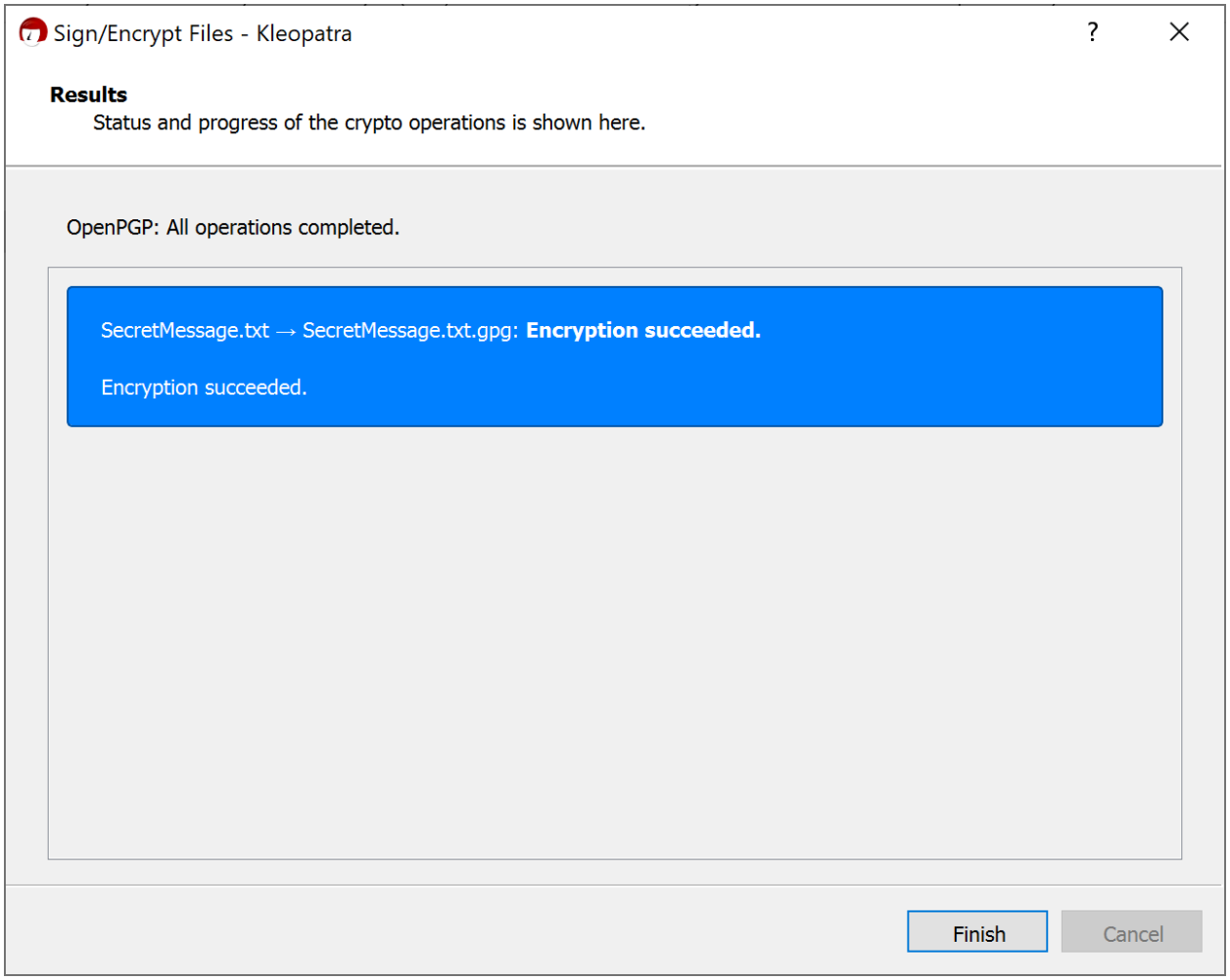
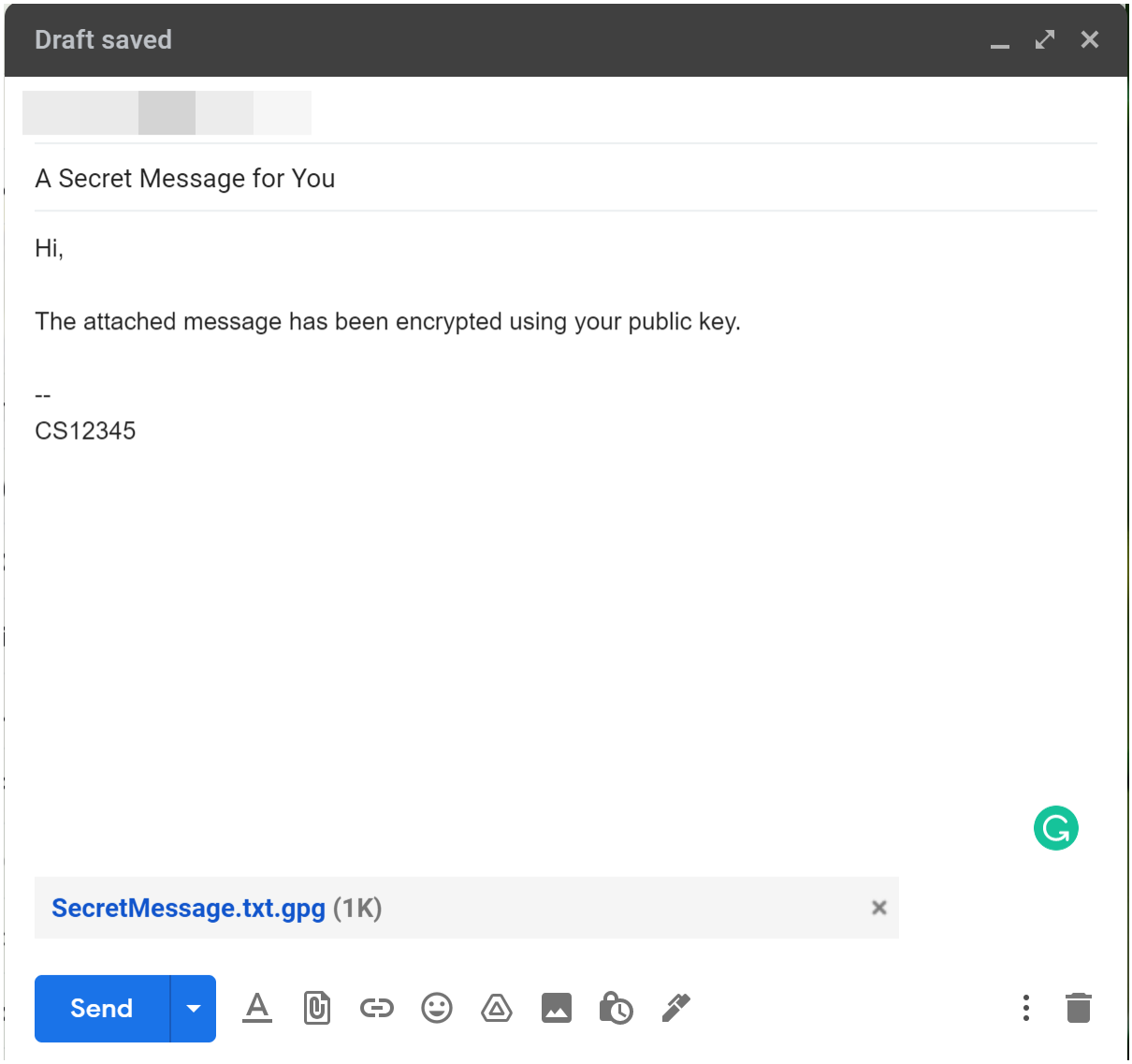
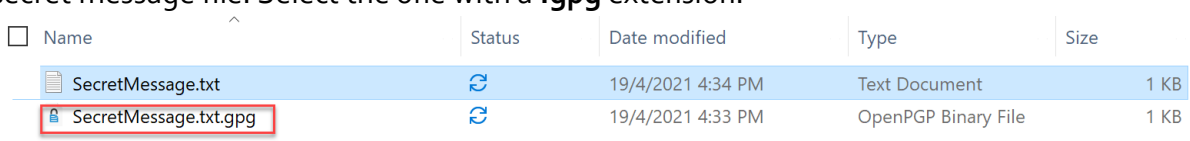


12. Well done! We now have the secret file that can be sent to our friend.
13. Next, open your email editor again. This time, we will attach the secret message we have encrypted before.



14. During the process of sending the email, make sure you select the correct version of the secret message file. Select the one with a **.gpg** extension.



Name	Status	Date modified	Type	Size
SecretMessage.txt		19/4/2021 4:34 PM	Text Document	1 KB
SecretMessage.txt.gpg		19/4/2021 4:33 PM	OpenPGP Binary File	1 KB

15. Send the email with the secret message to your friend. If you receive the email with a secret message from your friend, then you are ready for the next task, which is decryption.

`

TASK 5: DECRYPTING AN ENCRYPTED FILE

OBJECTIVE

To decrypt the encrypted file.

TASK DESCRIPTION

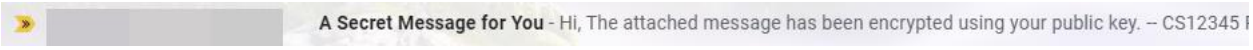
The student will decrypt the encrypted file by using their private key which has been managed and stored by Kleopatra software.

ESTIMATED TIME

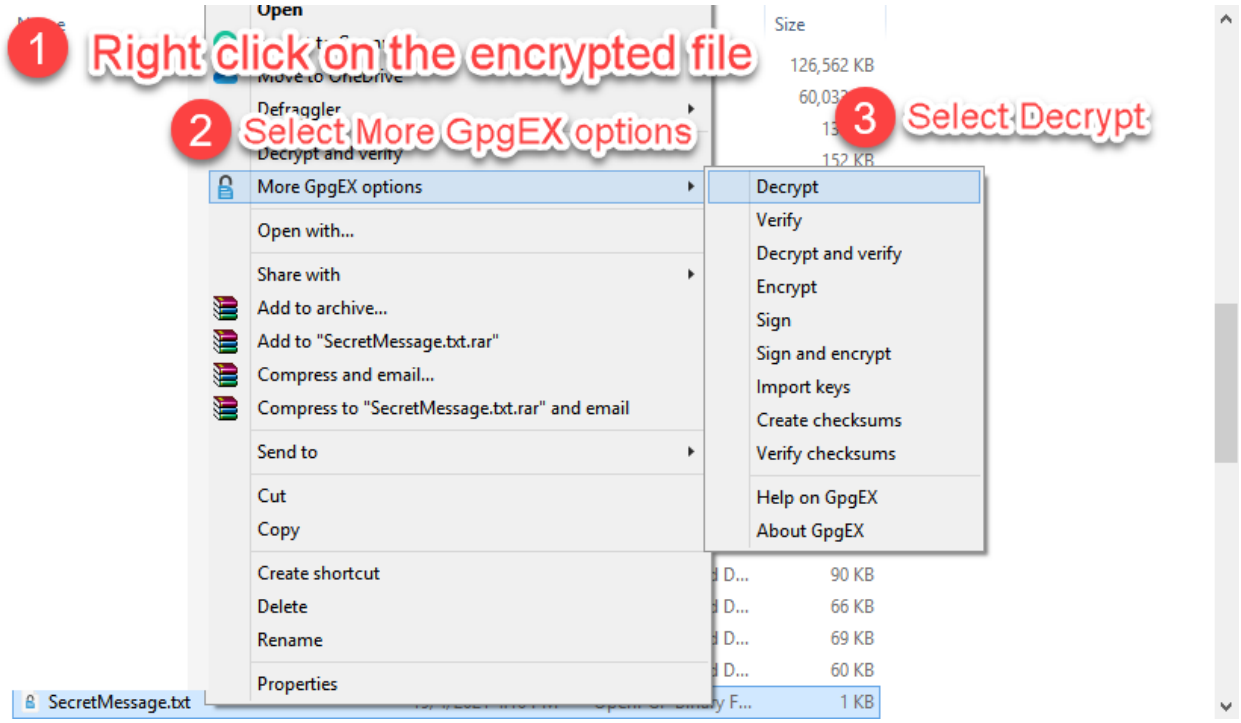
30 Minutes

STEPS:

1. To proceed with this task, make sure you have received an email with a secret message from your friend.

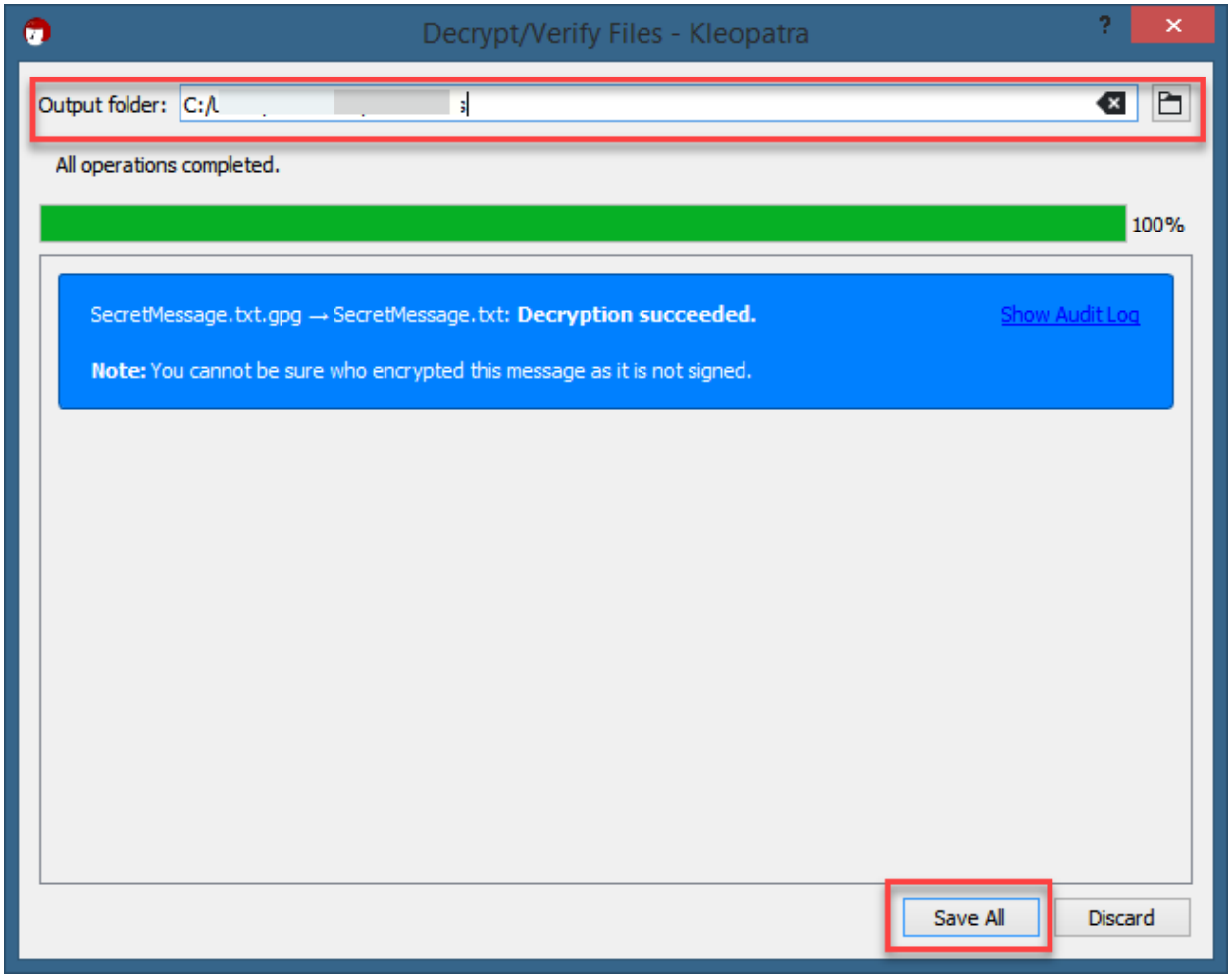


2. Download the attachment of the secret message to a safe location.
3. Next, go to the location of the encrypted file. Follow the steps on the screenshot:

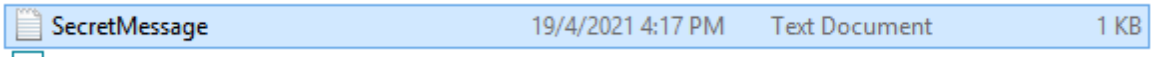


4. Wait until the decryption process complete and click **Save All** button. Take note of the location where the decrypted file being saved.

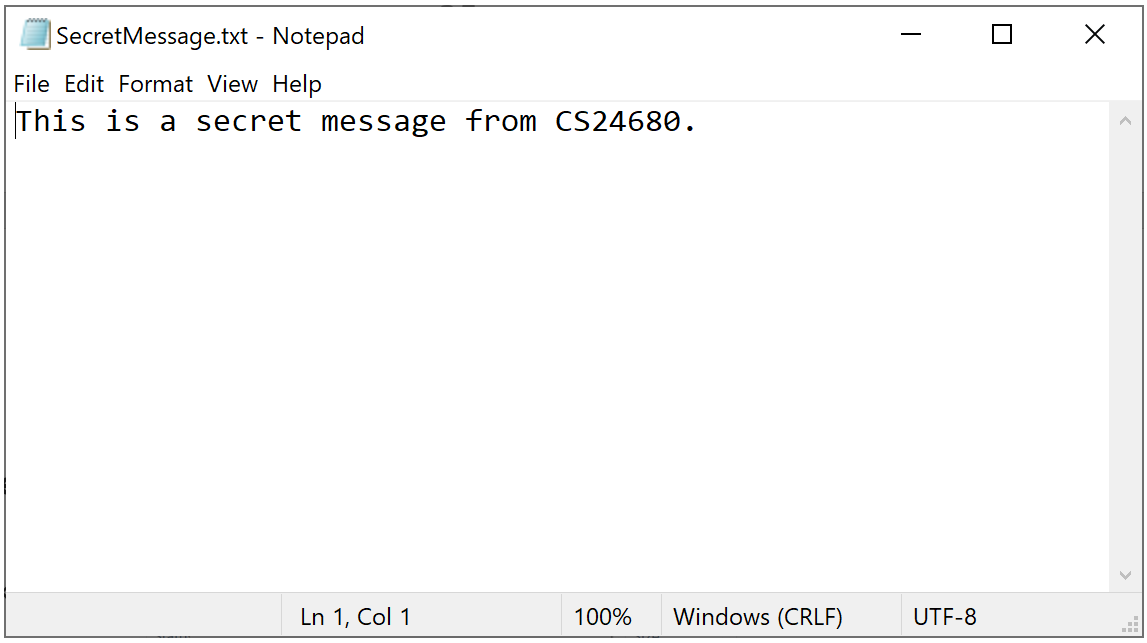
`



5. Go to the folder where the plain text is located. You will see the secret file is no more with the **.gpg** extension and now it becomes a **.txt** file.



6. Double click on the file icon and observe the content. Take a screenshot of the plaintext file you received from your friend put it into your lab report.



7. That's all for this task. In conclusion, you should have a clear idea of how asymmetric encryption works. You may use it for email, messaging and another medium of communications. Good job!

REFLECTION QUESTIONS

1.	Why cryptography is important in cybersecurity?
2.	Give one example of an application that applied cryptography in our daily life.
3.	Describe an example of such an application in question 2 which related to the objectives of cryptography.
4.	Describe five (5) differences between symmetric and asymmetric encryption for cryptography.
5.	List five (5) differences between cryptography and steganography.