PUBLIC KEY CRYPTOGRAPHY

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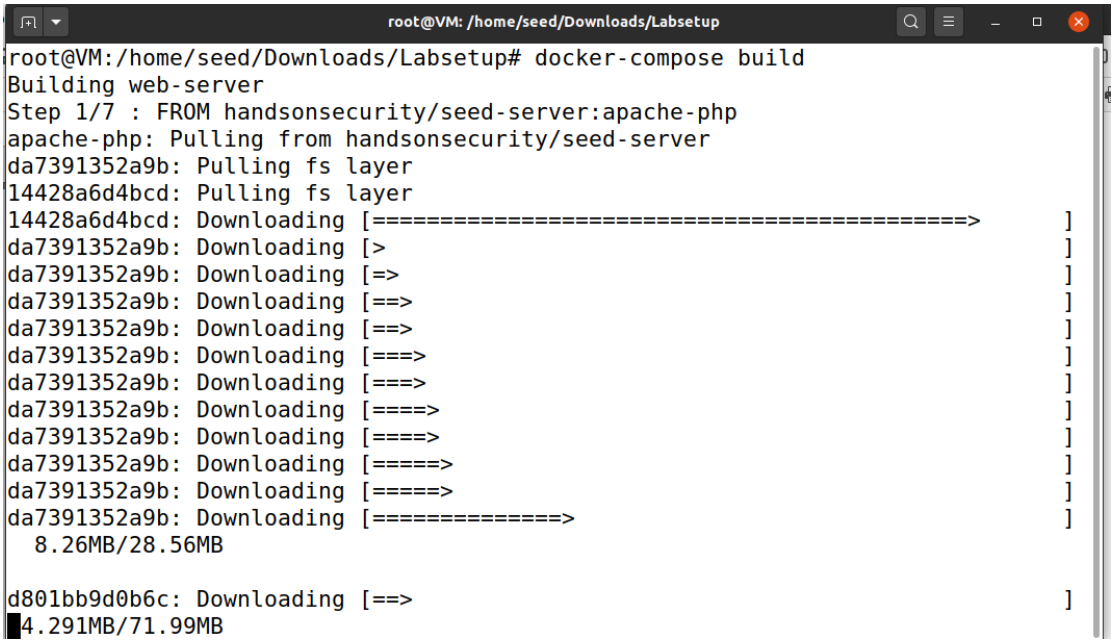
Section-1

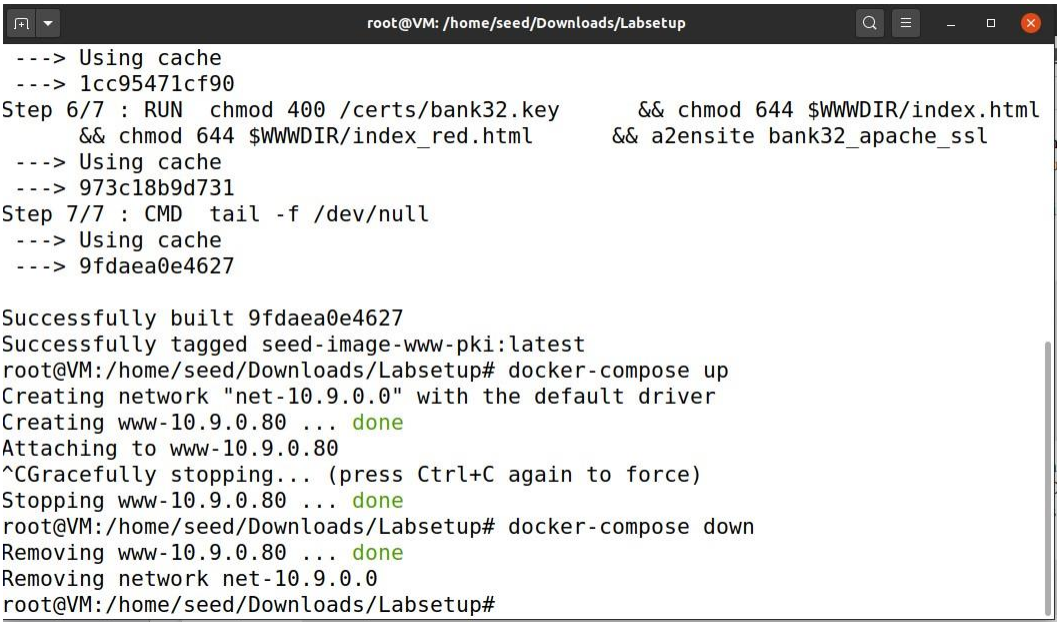
Public-Key Infrastructure Lab

Pre-Requisite Tasks: Container setup Commands and DNS setup

In the following, some of the commonly used commands related to Docker and Compose has been executed. Following are the screenshot

docker-compose build	# Build the container image
docker-compose up	# Start the container
docker-compose down	# Shut down the container
dcbuild	# Alias for: docker-compose build
dcup	# Alias for: docker-compose up
dcdown	# Alias for: docker-compose down

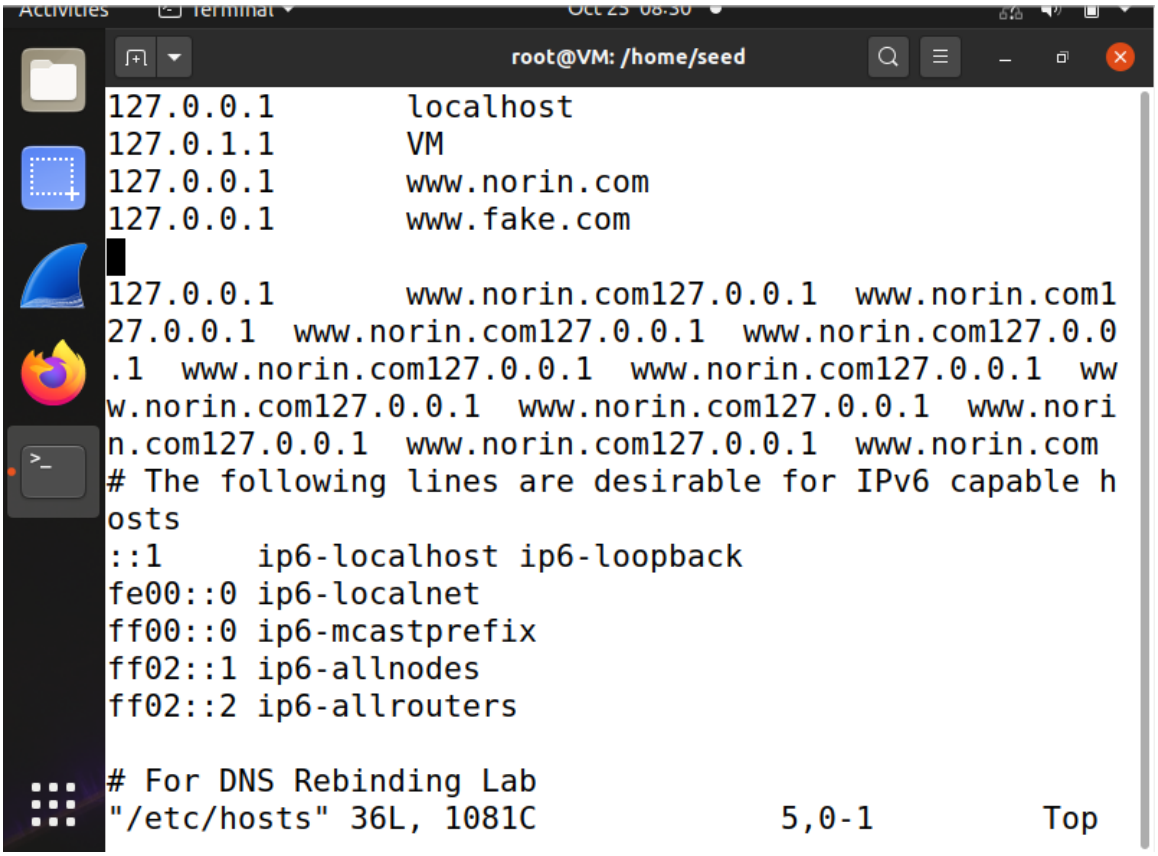



root@VM: /home/seed/Downloads/Labsetup
---> Using cache
---> 1cc95471cf90
Step 6/7 : RUN chmod 400 /certs/bank32.key && chmod 644 $WWWDIR/index.html
&& chmod 644 $WWWDIR/index_red.html && a2ensite bank32_apache_ssl
---> Using cache
---> 973c18b9d731
Step 7/7 : CMD tail -f /dev/null
---> Using cache
---> 9fdaea0e4627
Successfully built 9fdaea0e4627
Successfully tagged seed-image-www-pki:latest
root@VM:/home/seed/Downloads/Labsetup# docker-compose up
Creating network "net-10.9.0.0" with the default driver
Creating www-10.9.0.80 ... done
Attaching to www-10.9.0.80
^CGracefully stopping... (press Ctrl+C again to force)
Stopping www-10.9.0.80 ... done
root@VM:/home/seed/Downloads/Labsetup# docker-compose down
Removing www-10.9.0.80 ... done
Removing network net-10.9.0.0
root@VM:/home/seed/Downloads/Labsetup#


seed@VM: ~/.../Labsetup
root@710a2d02cad4: /
[10/18/22]seed@VM:~/.../Labsetup$ dockps
710a2d02cad4 www-10.9.0.80
[10/18/22]seed@VM:~/.../Labsetup$ docksh 71
root@710a2d02cad4:/#

DNS Setup:

We add two entries in /etc/hosts file. Screenshot is attached

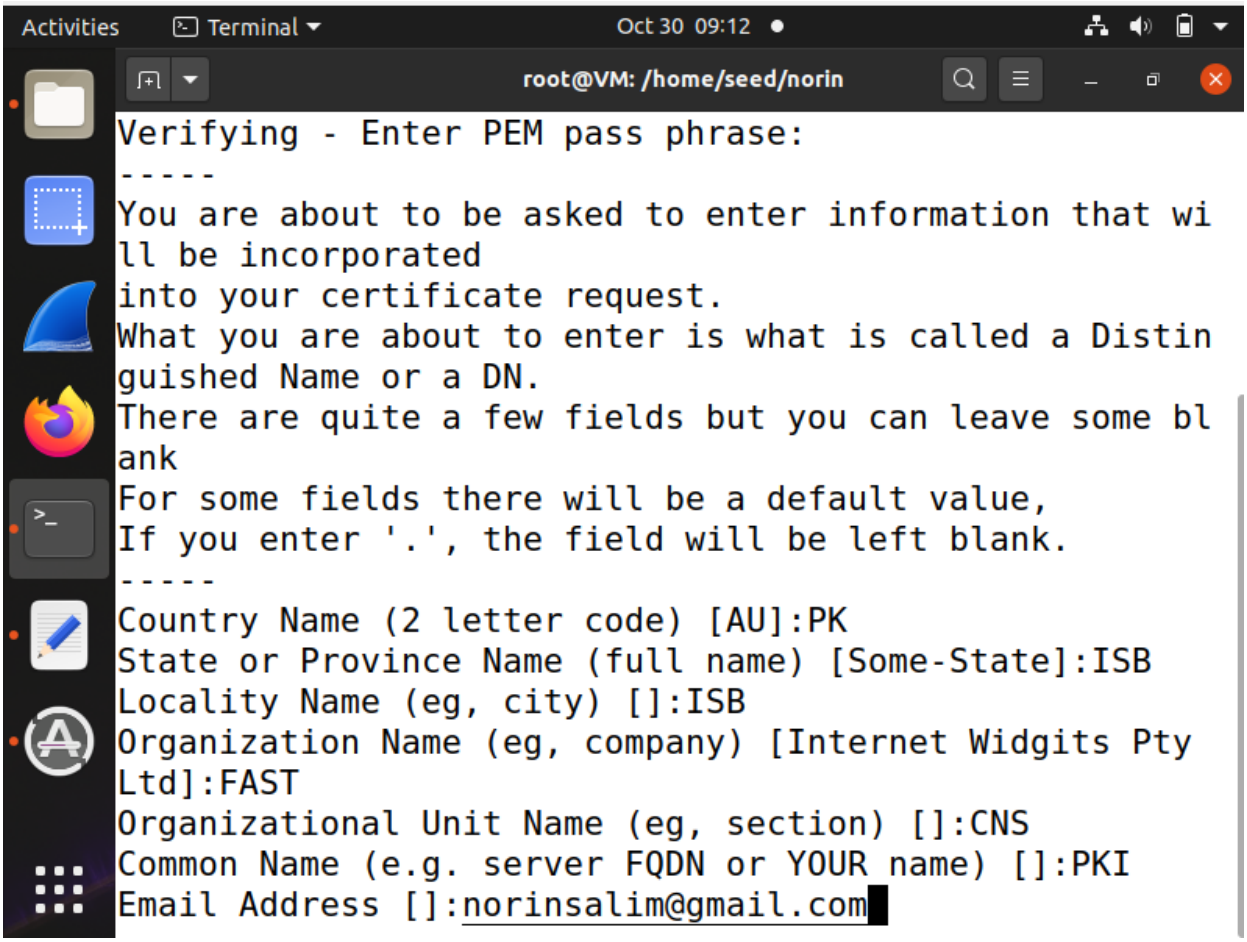


Task 1: Becoming a certificate authority

Certificate Authority (CA).

We need to generate a self-signed certificate for our CA. This means that this CA is totally trusted, and its certificate will serve as the root certificate. Following command has been used to generate the self-signed certificate for the CA:

openssl req -x509 -newkey rsa:4096 -sha256 -days 3650 \ -keyout ca.key -out ca.crt -config openssl.cnf




```
.............++++
.........................++++
writing new private key to 'ca.key'
Enter PEM pass phrase:
Verifying - Enter PEM pass phrase:
-----
You are about to be asked to enter information that will be incorporated
into your certificate request.
What you are about to enter is what is called a Distinguished Name or a DN.
There are quite a few fields but you can leave some blank
For some fields there will be a default value,
If you enter '.', the field will be left blank.
-----
Country Name (2 letter code) [AU]:PK
State or Province Name (full name) [Some-State]:ISB
Locality Name (eg, city) []:ISLAMABAD
Organization Name (eg, company) [Internet Widgits Pty Ltd]:FAST
Organizational Unit Name (eg, section) []:CS
Common Name (e.g. server FQDN or YOUR name) []:www.salim2022.com
Email Address []:i220033@nu.edu.pk
root@VM:/home/seed/Downloads/Labsetup#
```

```
        94:b9:a3:e5:77:ec:e3:e3:36:1a:d6:02:44:22:cd:66:5b:20:
        d6:b1:3a:2d:32:ea:80:33:47:32:b1:43:c0:12:99:92:c1:28:
        e0:4b:58:4d:d8:01:8c:cf:11:59:24:40:e5:6a:5e:29:e7:a9:
        5f:4b:09:c1:4c:b5:13:e7:9a:4f:c6:f4:6c:03:be:40:75:ca:
        52:dd:d2:bc:98:ce:18:85:dd:8b:9e:63:6d:04:aa:37:97:09:
        8c:5b:1c:af:21:8a:0f:7a:f6:bf:fd:1e:38:30:07:c1:74:71:
        50:36:2f:3f:48:ec:54:cb:ef:e1:9f:c2:47:ce:0b:5a:61:f6:
        36:bb:29:14:07:46:78:bf:62:9b:d7:50:2b:e1:2a:77:40:9f:
        84:8f:42:52:c6:f1:45:ee:44:c9:c9:00:68:81:c1:6b:b4:2d:
        61:4c:f8:63:0d:30:21:22:ee:41:9a:b5:70:85:ed:84:26:86:
        1b:f9:cb:bb:3d:22:dd:7c:08:9d:0d:9d:6d:c4:e3:7c:a3:e6:
        1a:b8:f2:d0:51:61:1c:cd:6d:77:ee:a0:ab:bc:4c:d3:63:90:
        fb:19:7a:a2:e3:d1:5d:e4
root@VM:/home/seed/Downloads/Labsetup# openssl req -x509 -newkey rsa:4096 -sha256 -days 3650 \-key
out ca.key -out ca.crt  \-subj "/CN=www.modelCA.com/O=Model CA LTD./C=US" \-passout pass:dee
Generating a RSA private key
.......................++++
.............................................................++++
writing new private key to 'ca.key'
-----
root@VM:/home/seed/Downloads/Labsetup#
```

PKI - Word

Right Ctrl

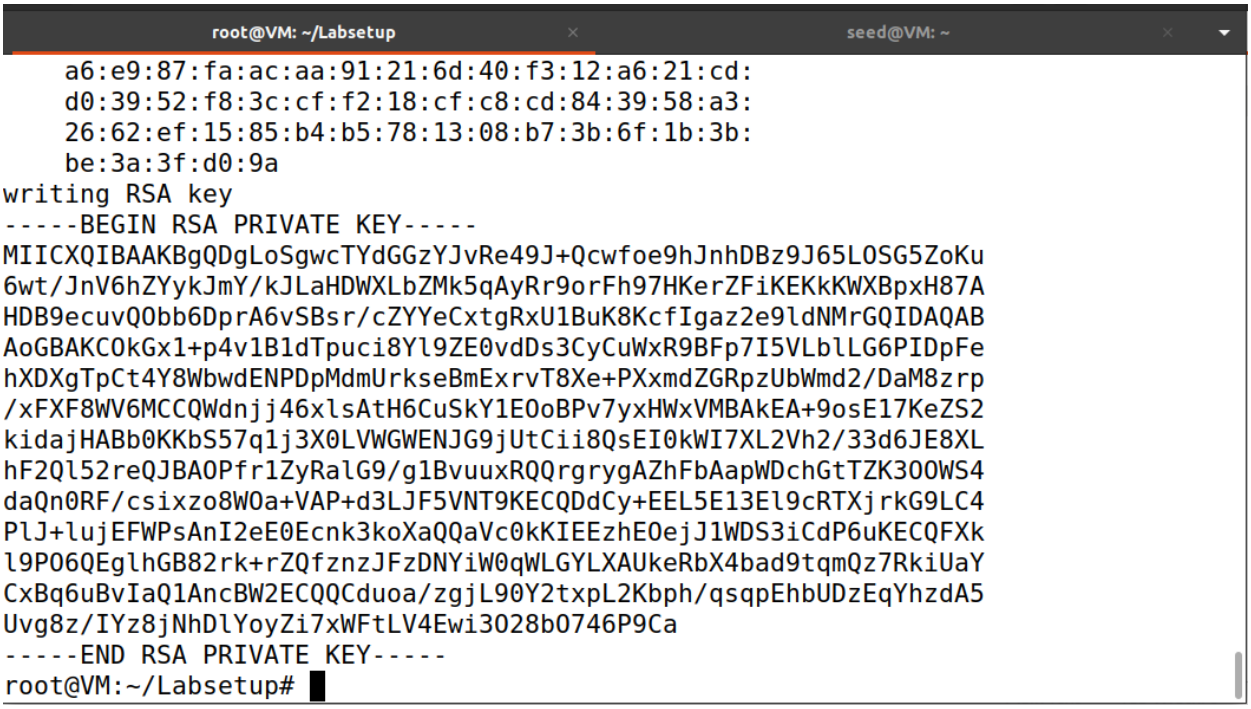
Task 2: Generating a certificate request for your web server

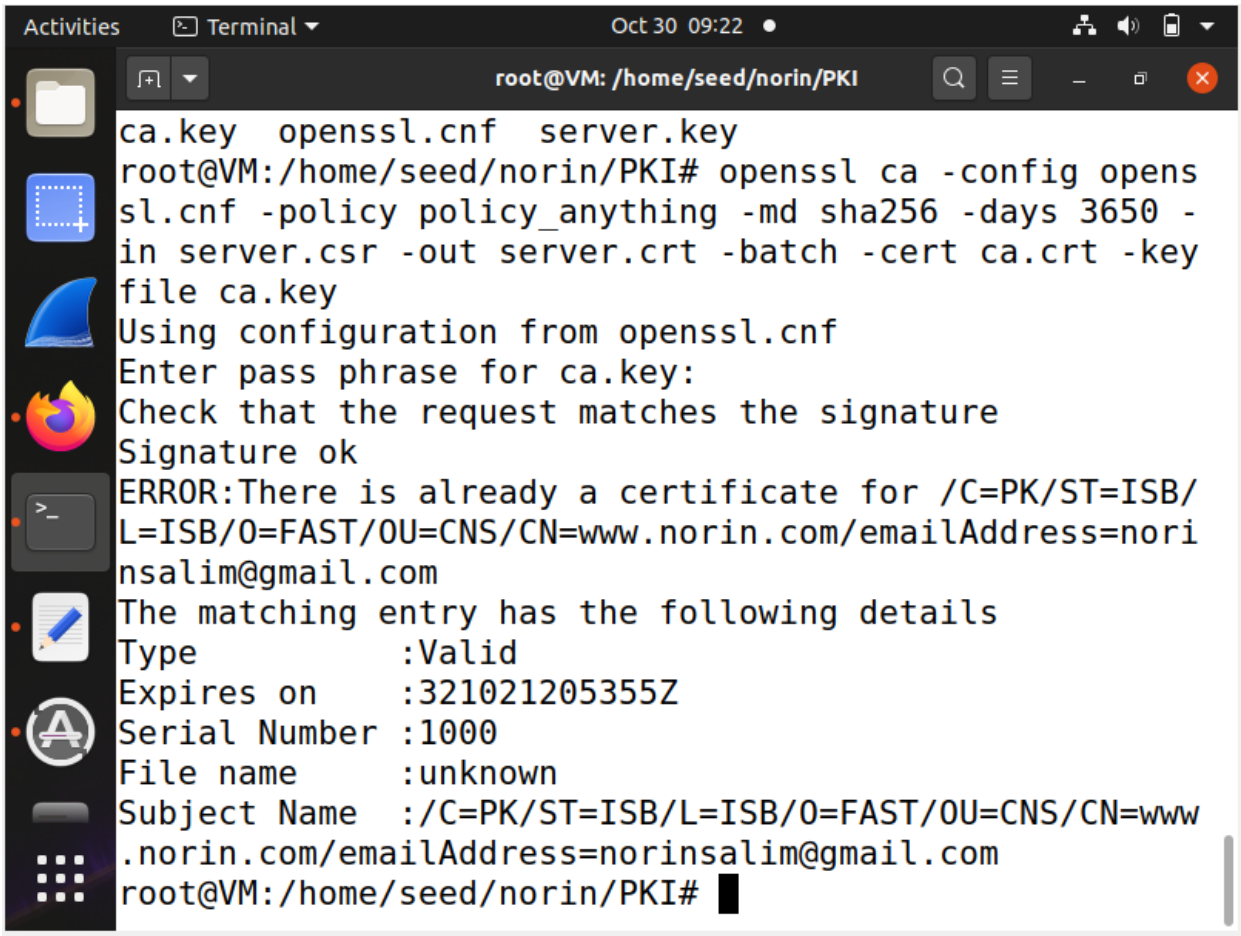
The command will generate a pair of public/private key, and then create a certificate signing request from the public key.

openssl req -newkey rsa:2048 -sha256 \ -keyout server.key -out server.csr -config openssl.cnf

```
        98:dc:ed:a2:e4:4c:7e:91:b5:cc:0f:f8:e6:14:2e:70:fb:07:
        71:f6:f1:32:09:d7:b0:48:77:97:71:5d:73:a3:09:aa:2b:90:
        a0:91:f7:f9:97:73:d6:96:ab:55:2b:bd:db:10:eb:ee:72:97:
        e1:57:b3:2f:b8:ba:b1:bb:93:f1:76:17:79:f0:32:87:b8:24:
        d5:c3:05:11:a0:66:44:4c:3b:27:cf:94:68:9c:72:ed:ab:56:
        65:99:38:2a:c8:b7:7a:bc:e9:77:3f:66:6c:04:a5:38:8c:43:
        1d:a3:a9:2e:c6:87:9e:df:5f:2e:26:1e:15:99:3d:b7:9c:d1:
        fa:38:d1:97:9b:6a:d3:b8:6f:e4:69:8b:2d:14:44:54:b4:69:
        a1:31:82:20:41:ca:c3:83:d3:32:46:17:57:00:8c:35:e1:b7:
        b2:38:53:c6:7e:50:e5:56:2d:dc:35:27:b4:92:51:d9:3c:97:
        e2:a0:29:2a:79:6c:89:c9
root@VM:/home/seed/Downloads/Labsetup#
root@VM:/home/seed/Downloads/Labsetup#
root@VM:/home/seed/Downloads/Labsetup# openssl req -newkey rsa:2048 -sha256  \-keyout server.key
 -out server.csr  \-subj "/CN=www.salim2022.com/O=salim2022 Inc./C=US" \-passout pass:dees
Generating a RSA private key
.....+++++
...............................+++++
writing new private key to 'server.key'
-----
root@VM:/home/seed/Downloads/Labsetup#
```

Right Ctrl


root@VM: ~/Labsetup
seed@VM: ~
a6:e9:87:fa:ac:aa:91:21:6d:40:f3:12:a6:21:cd:
d0:39:52:f8:3c:cf:f2:18:cf:c8:cd:84:39:58:a3:
26:62:ef:15:85:b4:b5:78:13:08:b7:3b:6f:1b:3b:
be:3a:3f:d0:9a
writing RSA key
-----BEGIN RSA PRIVATE KEY-----
MIICXQIBAAKBgQDgLoSgwcTYdGGzYJvRe49J+Qcwfoe9hJnhDBz9J65LOSG5ZoKu
6wt/JnV6hZYykJmY/kJLaHDWXLbZMk5qAyRr9orFh97HKerZFiKEKkKWXBpxH87A
HDB9ecuvQObb6DprA6vSBsr/cZYYeCxtgRxU1BuK8KcfIgaz2e9ldNMrGQIDAQAB
AoGBAKCOkGx1+p4v1B1dTpuci8Yl9ZE0vdDs3CyCuWxR9BFp7I5VLblLG6PIDpFe
hXDXgTpCt4Y8WbwdENPDpMdmUrkseBmExrvT8Xe+PXxmdZGRpzUbWmd2/DaM8zrp
/xFXF8WV6MCCQWdnjj46xlsAtH6CuSkY1EOoBPv7yxHWxVMBAkEA+9osE17KeZS2
kidajHABb0KKbS57q1j3X0LVWGWENJG9jUtCii8QsEI0kWI7XL2Vh2/33d6JE8XL
hF2Ql52reQJBAOPfr1ZyRalG9/g1BvuuxRQQrgrygAZhFbAapWDchGtTZK3OOWS4
daQn0RF/csixzo8WOa+VAP+d3LJF5VNT9KECQDdCy+EEL5E13El9cRTXjrkG9LC4
PlJ+lujEFWPsAnI2eE0Ecnk3koXaQQaVc0kKIEEzhEOejJ1WDS3iCdP6uKECQFXk
l9PO6QEglhGB82rk+rZQfznzJFzDNYiW0qWLGYLXAUkeRbX4bad9tqmQz7RkiUaY
CxBq6uBvIaQ1AncBW2ECQQCduoa/zgjL90Y2txpL2Kbph/qsqpEhbUDzEqYhzdA5
Uvg8z/IYz8jNhDlYoyZi7xWFtLV4Ewi3O28bO746P9Ca
-----END RSA PRIVATE KEY-----
root@VM:~/Labsetup#


Activities
Terminal
Oct 30 09:22
root@VM: /home/seed/norin/PKI
ca.key openssl.cnf server.key
root@VM:/home/seed/norin/PKI# openssl ca -config opens
sl.cnf -policy policy_anything -md sha256 -days 3650 -
in server.csr -out server.crt -batch -cert ca.crt -key
file ca.key
Using configuration from openssl.cnf
Enter pass phrase for ca.key:
Check that the request matches the signature
Signature ok
ERROR:There is already a certificate for /C=PK/ST=ISB/
L=ISB/O=FAST/OU=CNS/CN=www.norin.com/emailAddress=nori
nsalim@gmail.com
The matching entry has the following details
Type   :Valid
Expires on   :321021205355Z
Serial Number :1000
File name   :unknown
Subject Name   :/C=PK/ST=ISB/L=ISB/O=FAST/OU=CNS/CN=www
.norin.com/emailAddress=norinsalim@gmail.com
root@VM:/home/seed/norin/PKI#

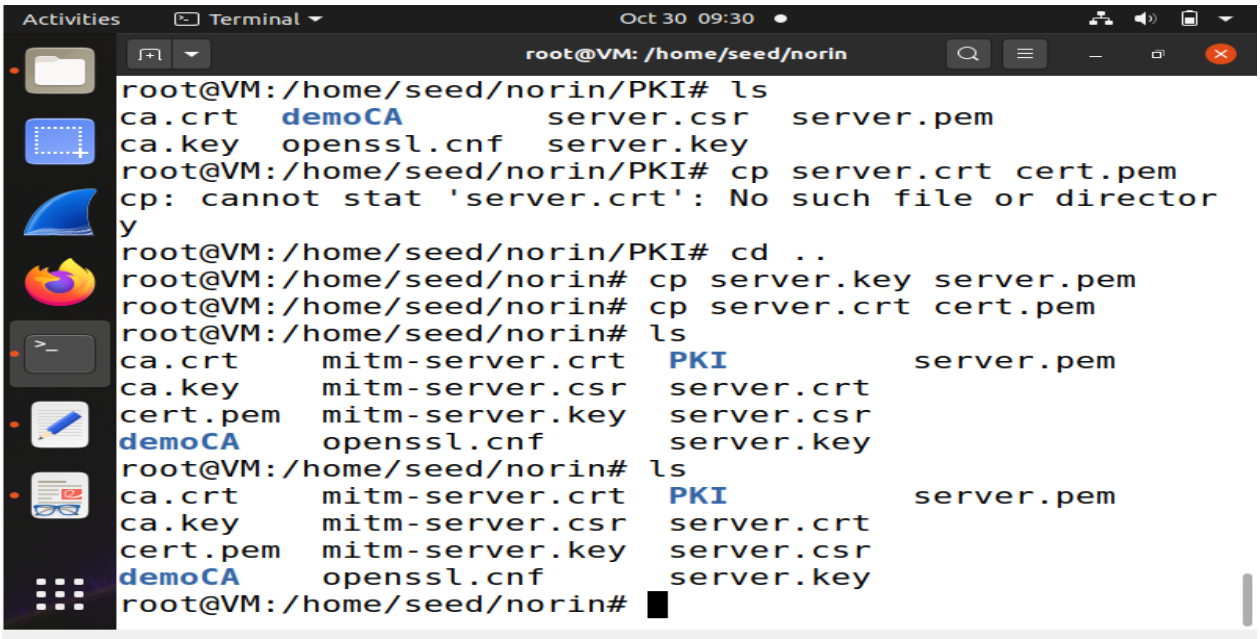
Task 3: Generating a certificate for your server

Combine the secret key and certificate into one file through cp server.key server.pem

% cat server.crt >> server.pem

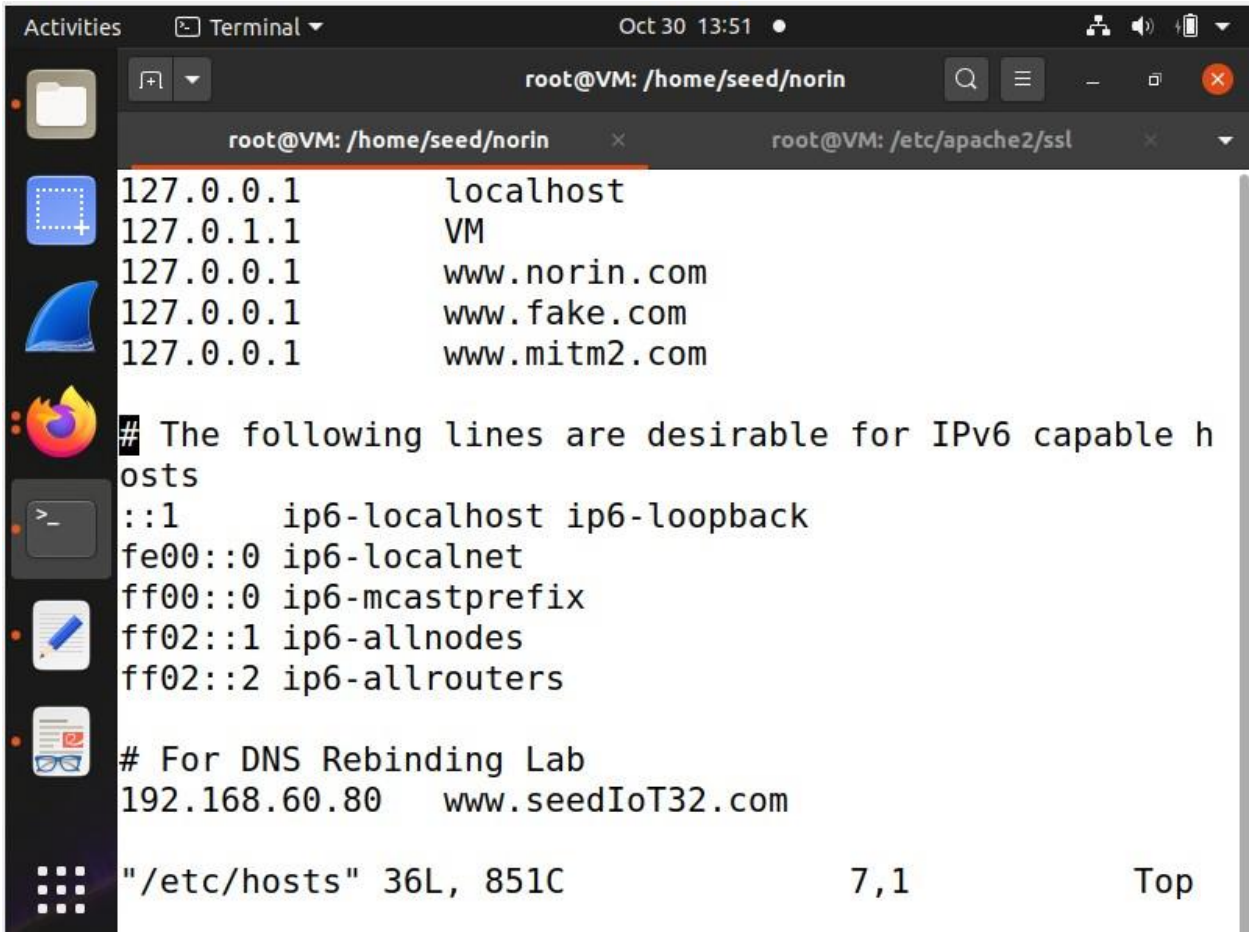
Launch the web server using server.pem

% openssl s_server -cert server.pem -www

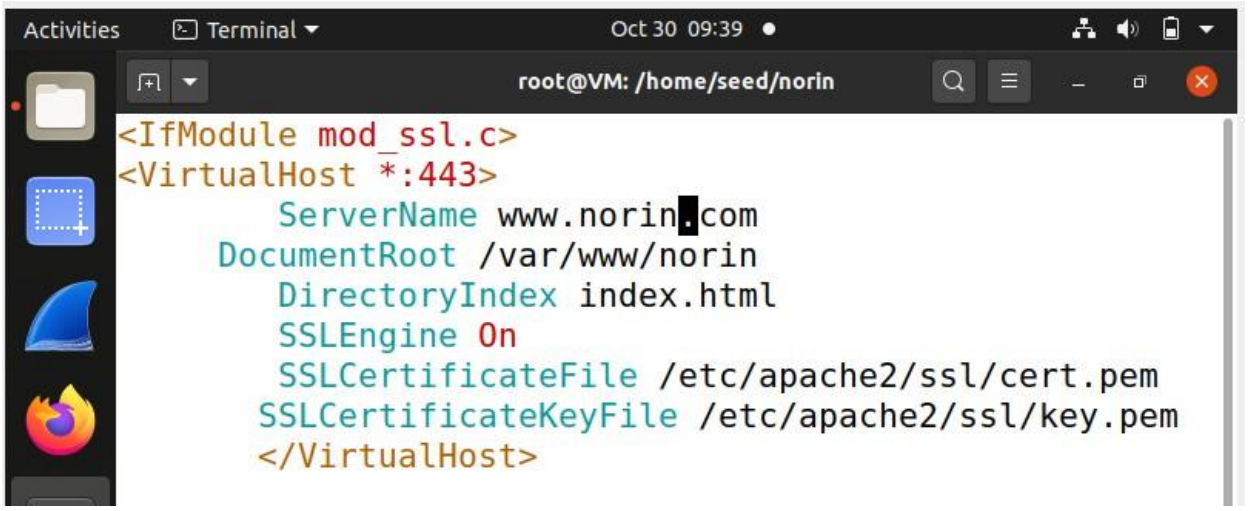


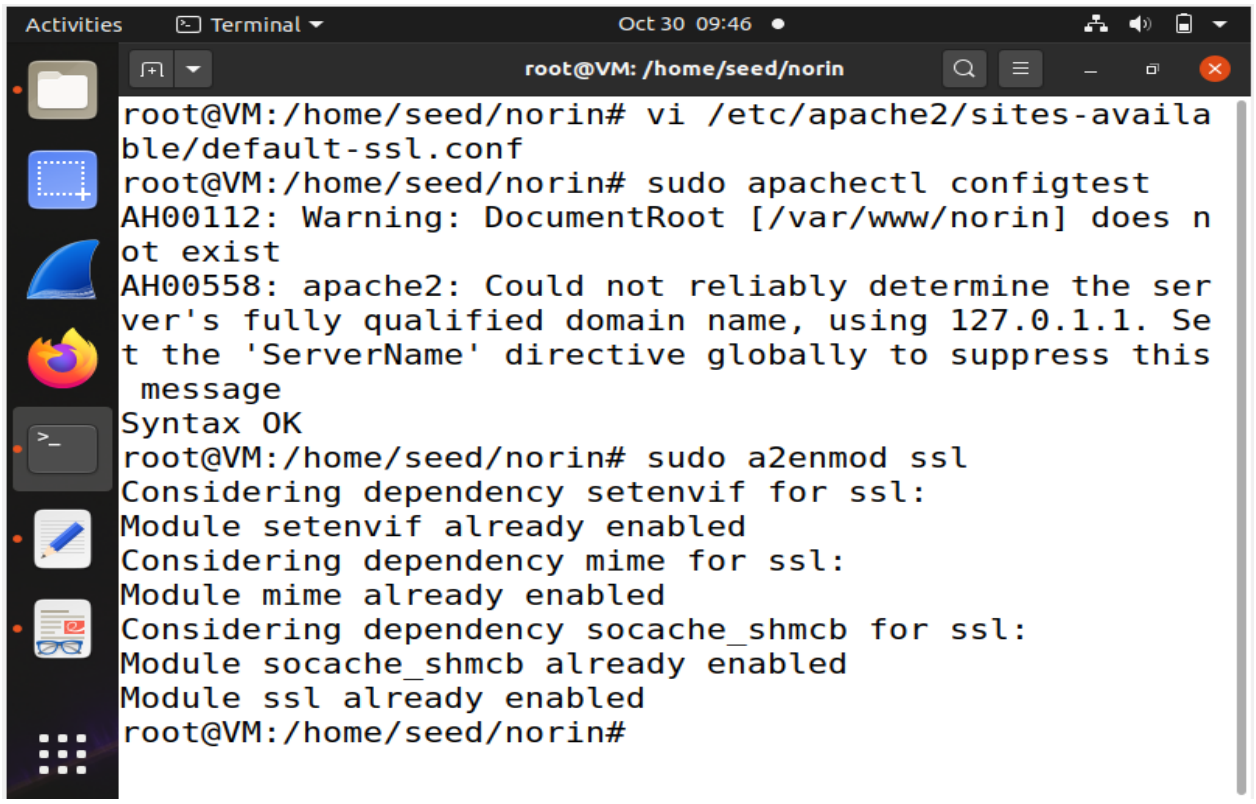
Task 4: Deploying Certificate in an Apache-Based HTTPS Website

Add entry in /etc/hosts file

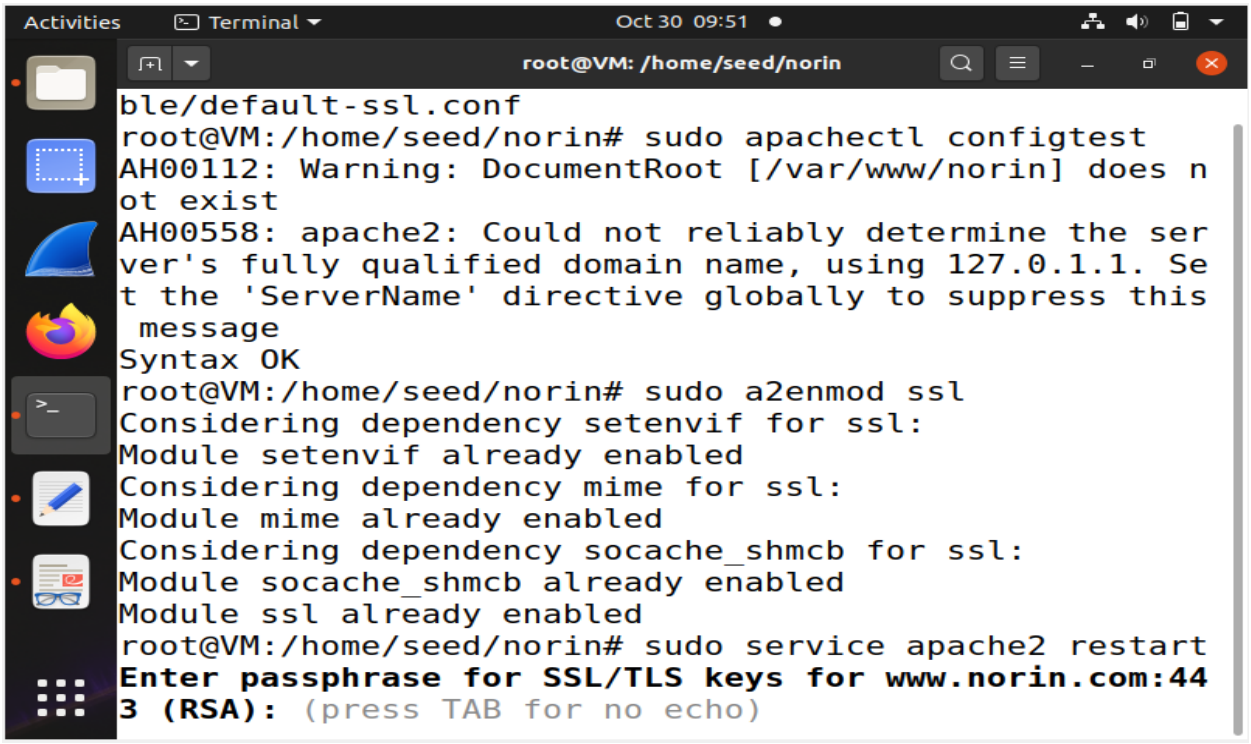


Command: Edit Apache conf file through command vi /etc/apache2/sites-available/default-ssl.conf

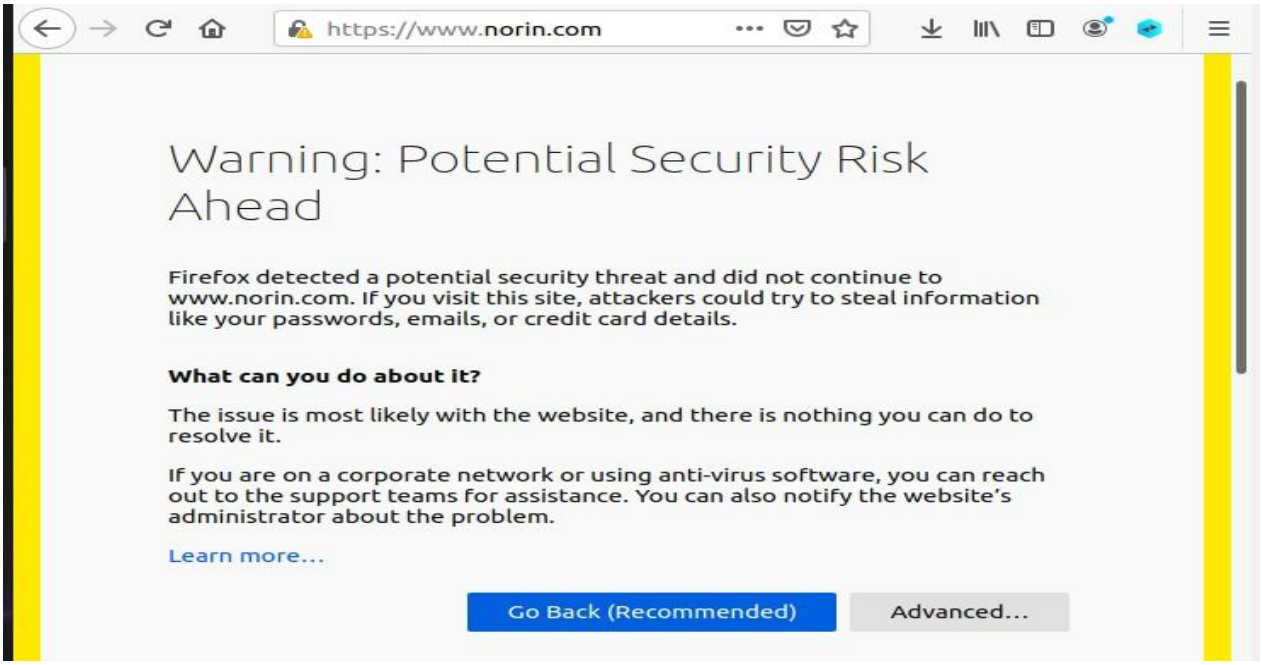




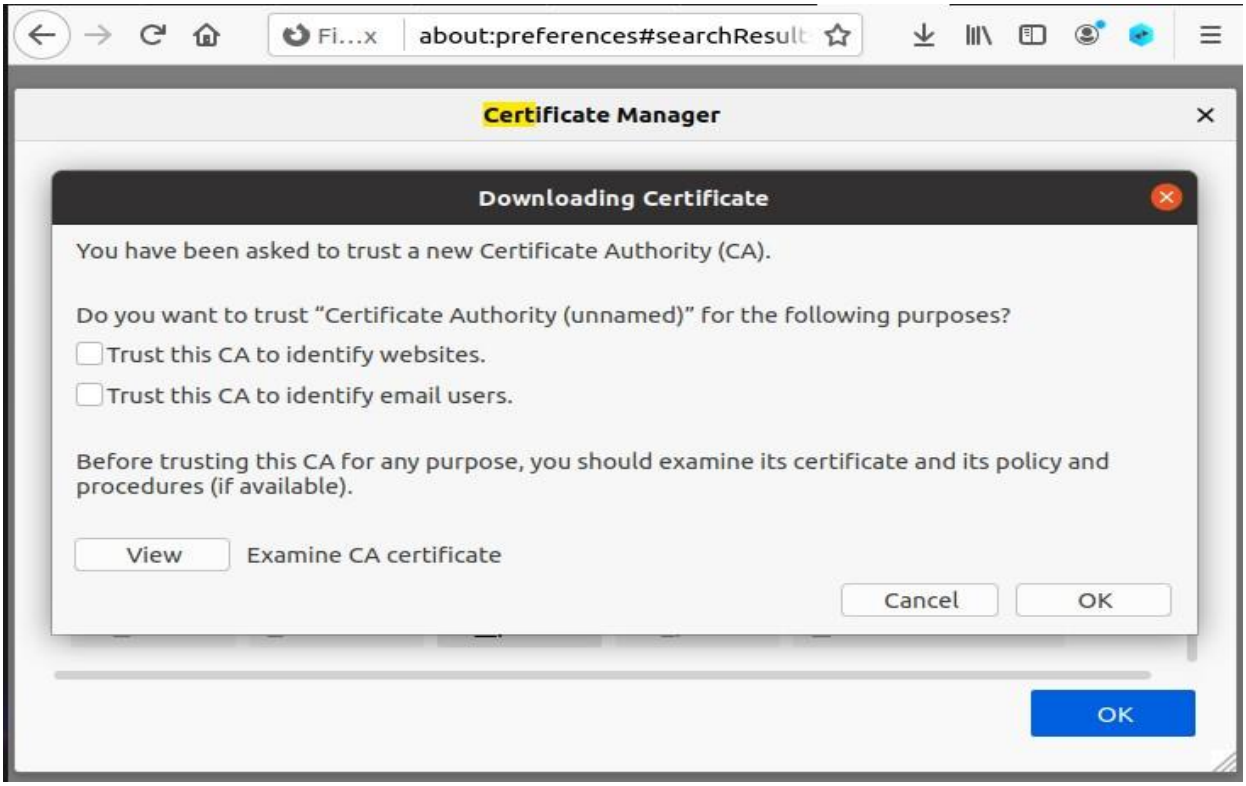
Restarted Apache:



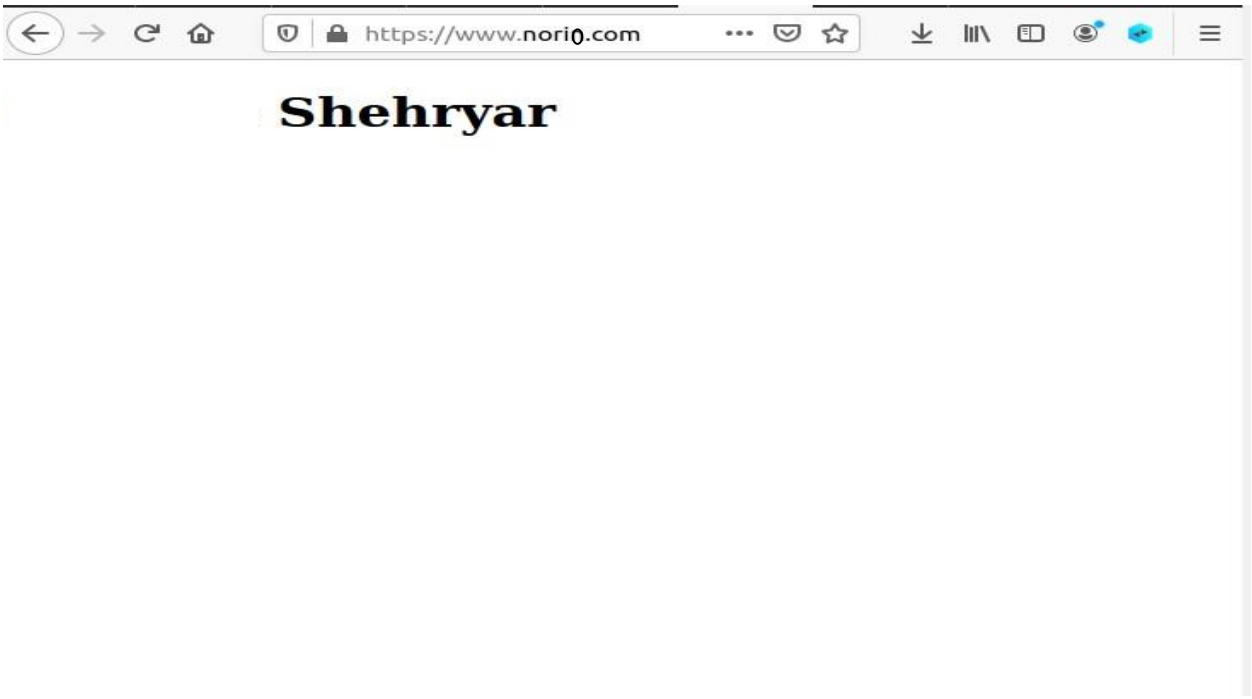
Website without importing the certificate:



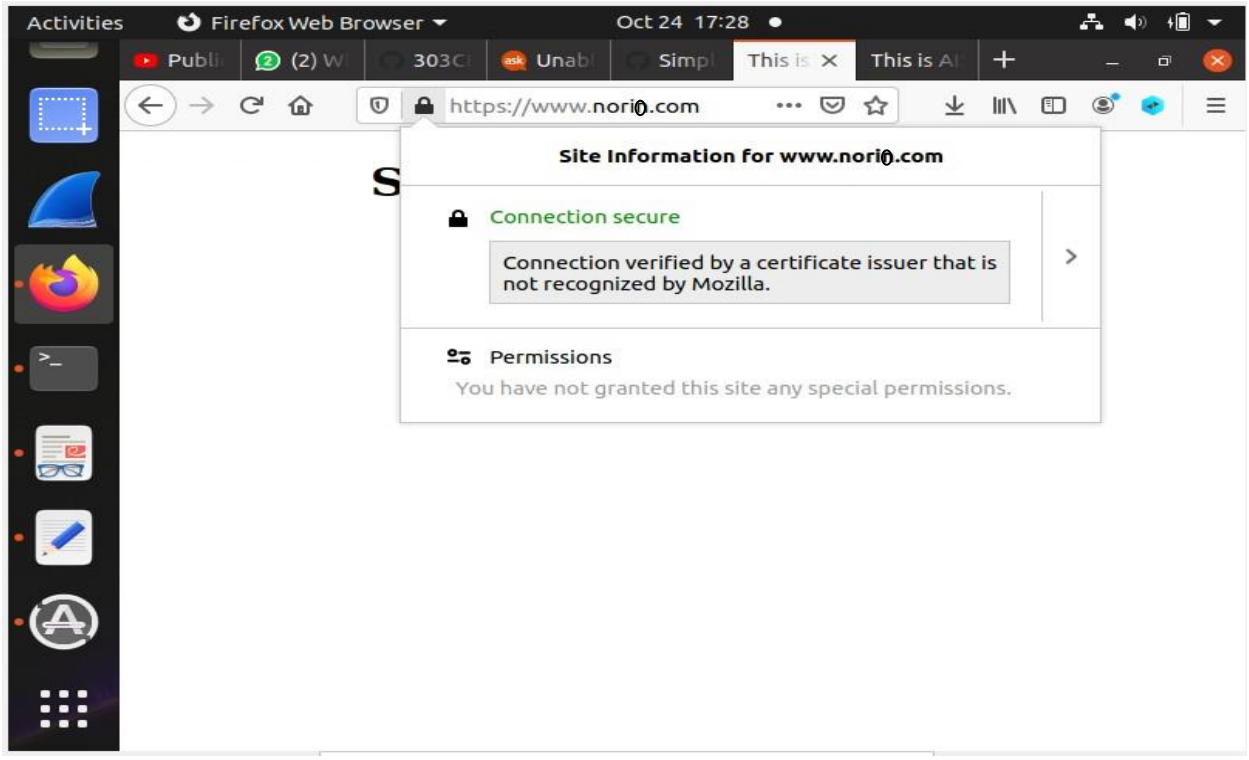
We imported the certificate on the browser here:



Here is website with valid certificate:

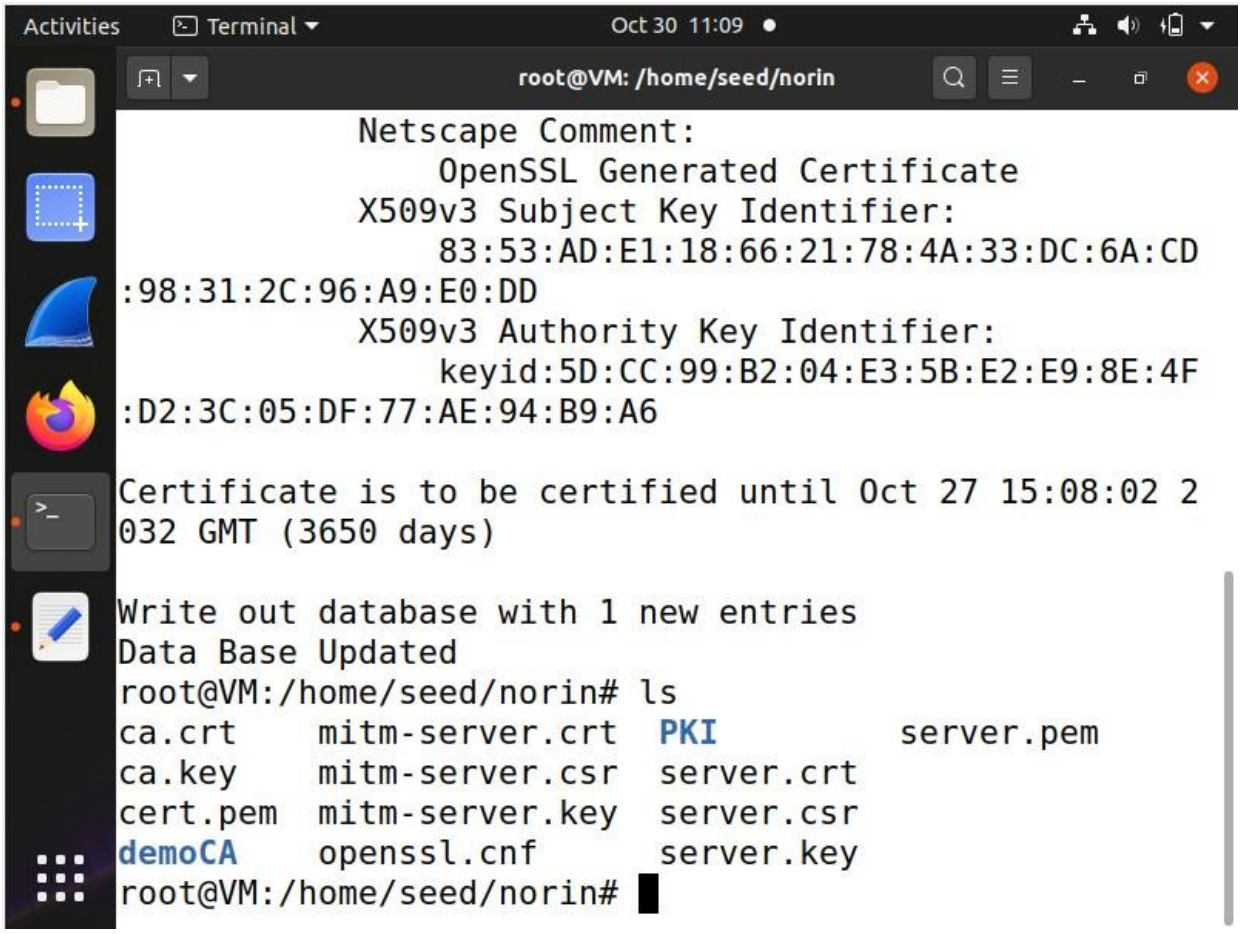


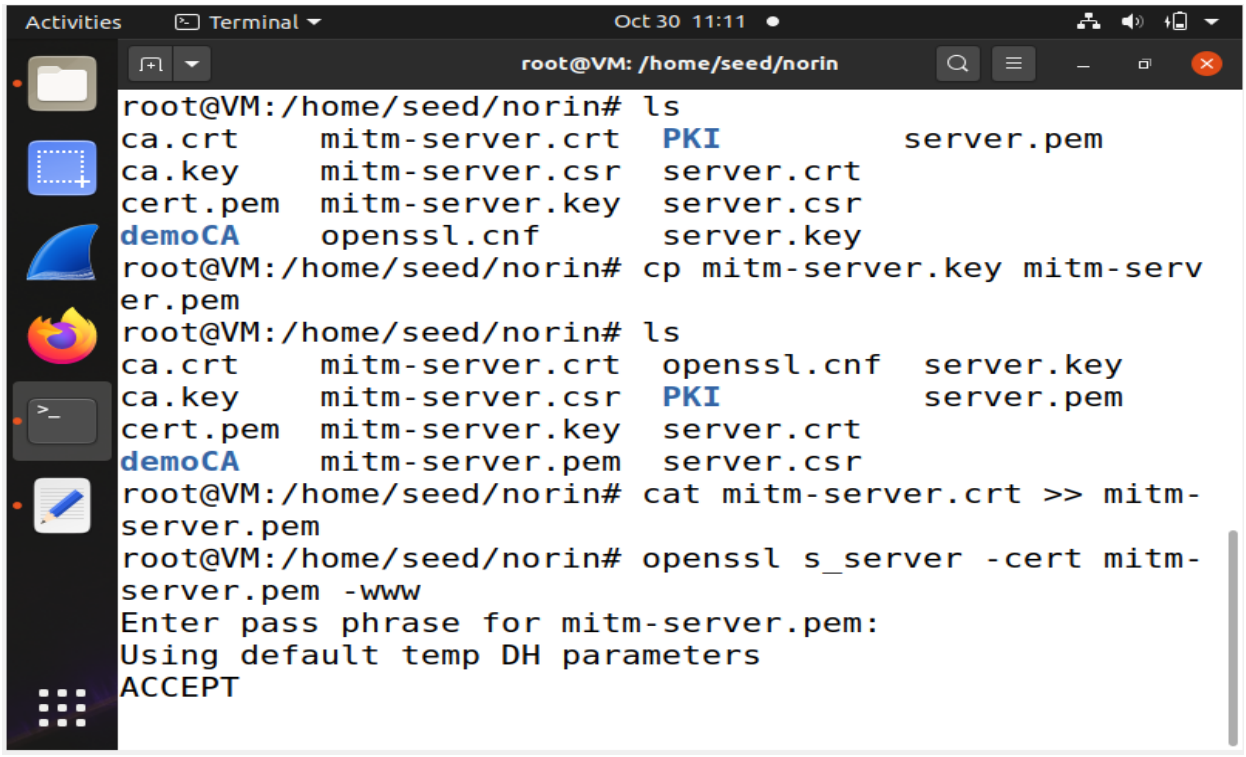
Screenshot is attached with valid certificate info



Task 5: Launching a Man-in-the-Middle attack

Signing the server with already generated ca.key

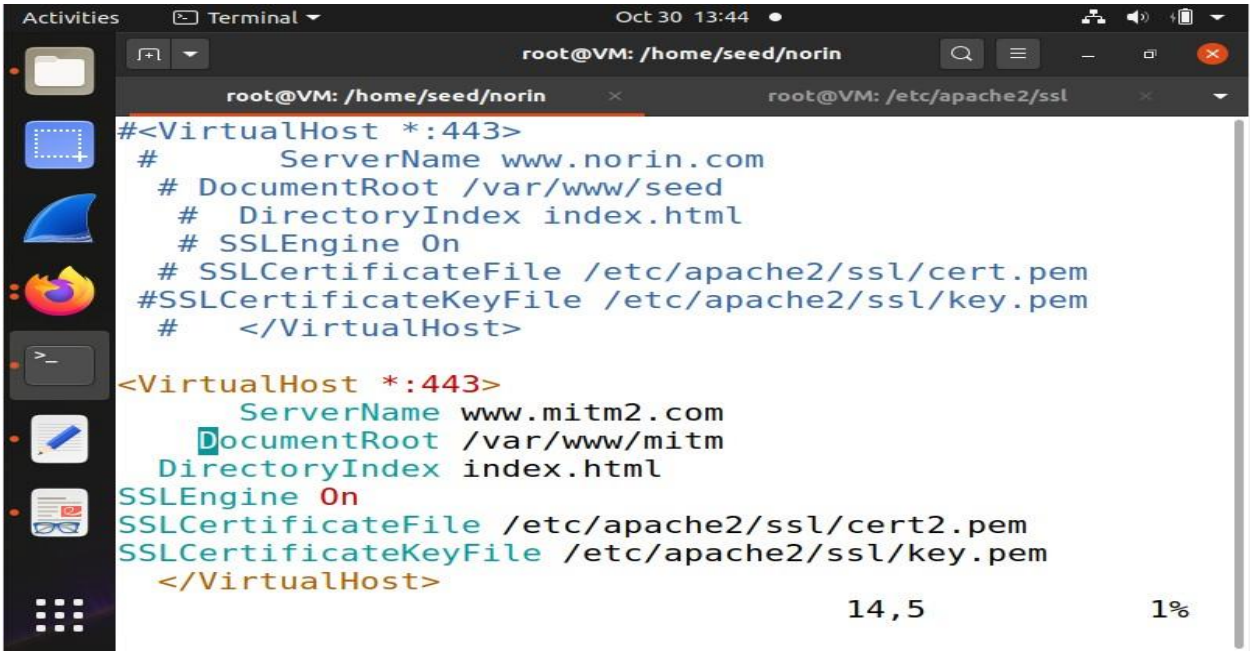




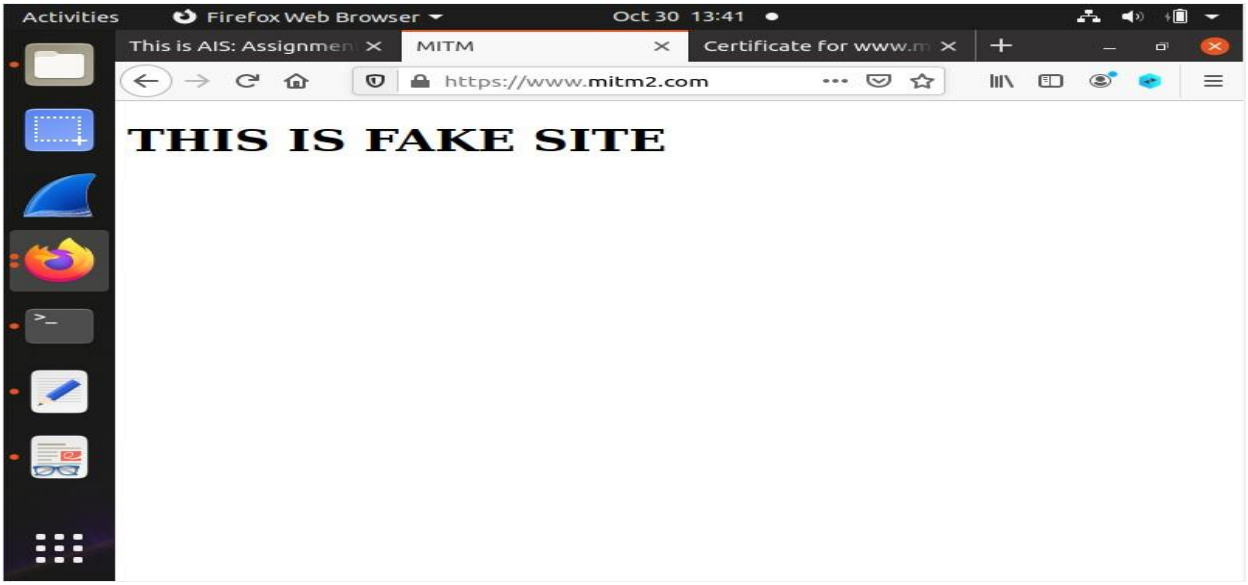
Step 1: Setting up the malicious website.

Step 2: Becoming the man in the middle.

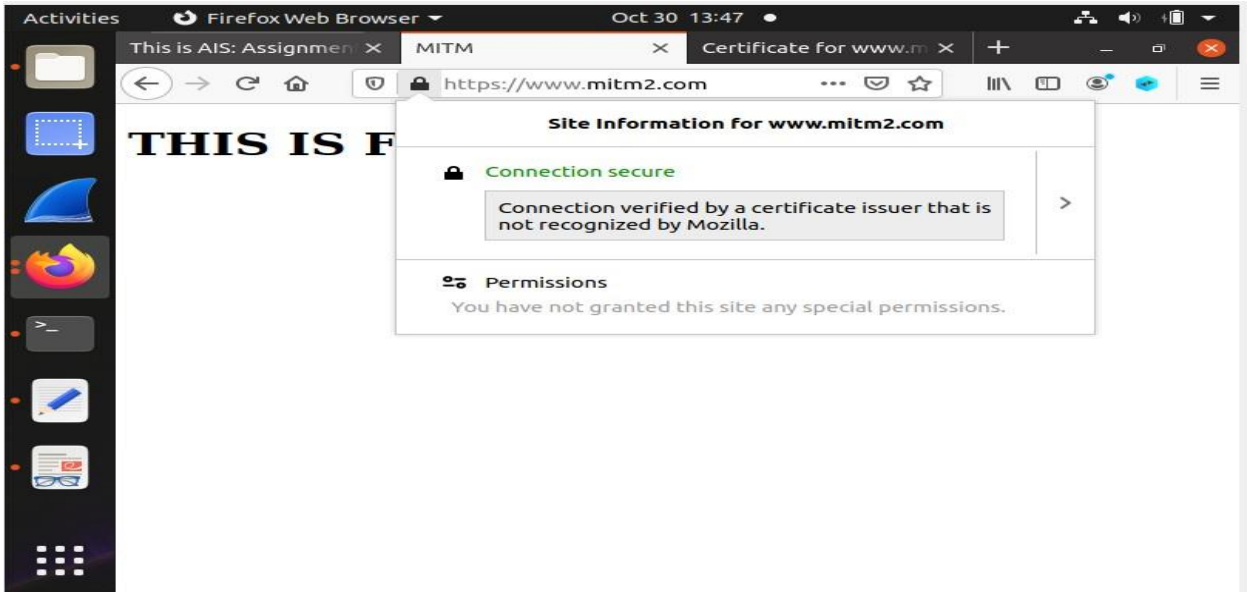
Edit Apache conf file through command vi /etc/apache2/sites-available/default-ssl.conf

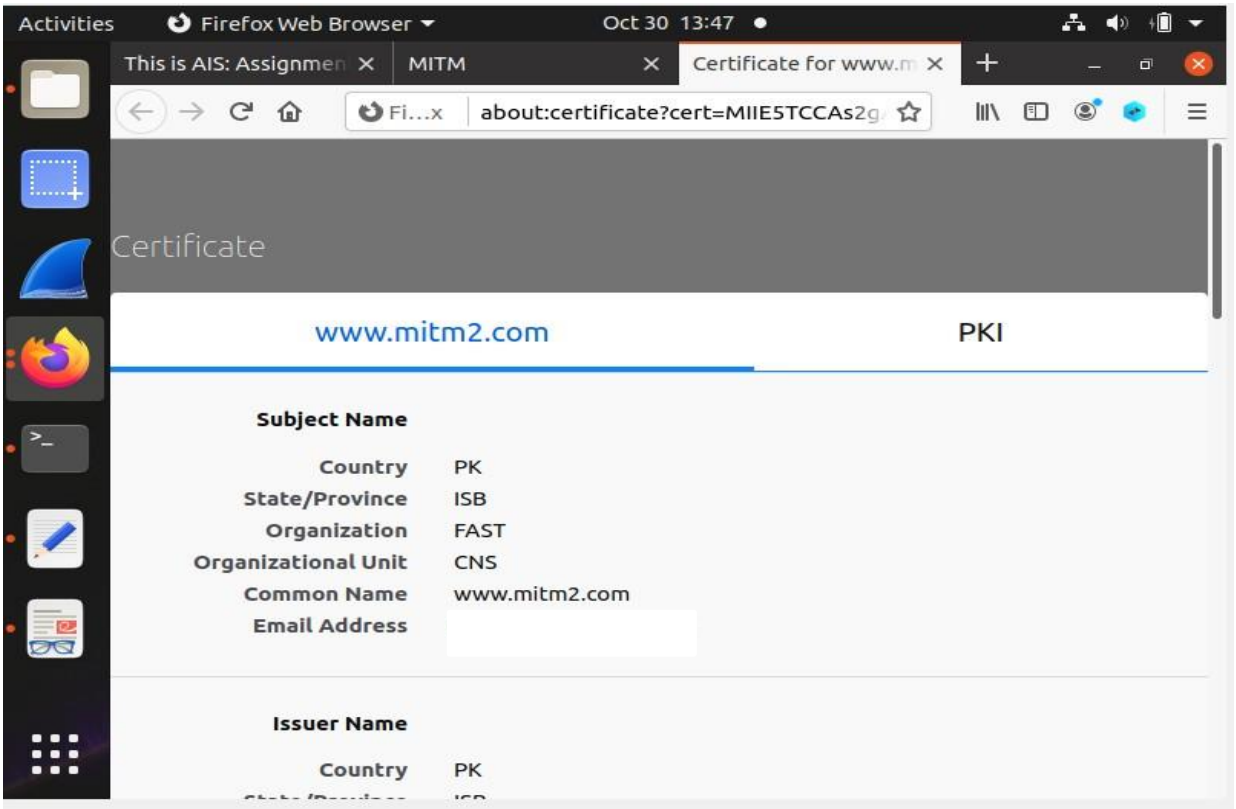


Step 3: Browse the target website.



Task 6: Launching a Man-in-the-Middle attack with a compromised CA.



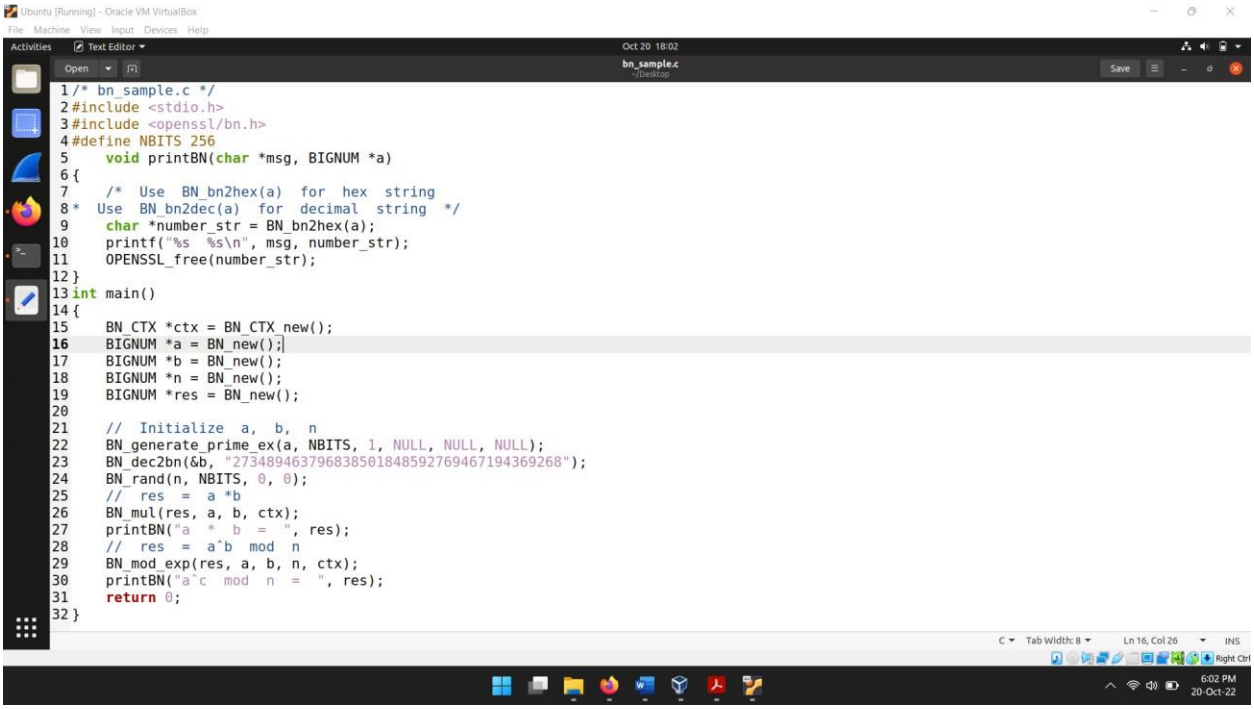


Section-2

RSA Encryption and Signature Lab

Pre-Requisite Tasks: Implement the BigNum example, compile and execute it.

First, we will write all our C language code in Text Editor and save it as ***bn_sample.c***. In the code we initialize a,b,n for BigNum example and used ***<openssl/bn.h>*** library for Big Number problem solution. a*b and (a^b mod n) will be used for computation.



Now we open Terminal and write commands:

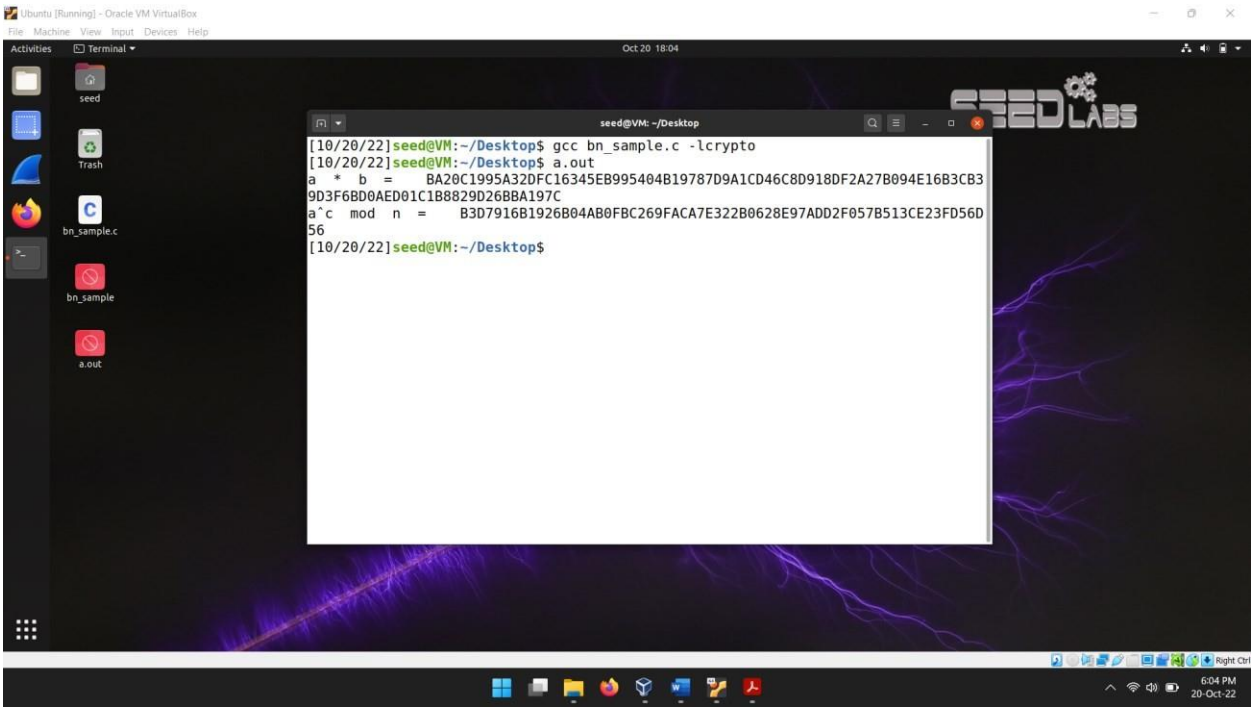
gcc bn_sample.c -lcrypto to compile our C program,

a.out to run our C program.

After '–' its small L, not the number 1(it tells compiler to use crypto library). its compiled and run successfully and we got following response:

a * b =
BA20C1995A32DFC16345EB995404B19787D9A1CD46C8D918DF2A27B094E16B3CB39D3F6BD0AED01C1B8829D26BBA197C

a^c mod n =
B3D7916B1926B04AB0FBC269FACA7E322B0628E97ADD2F057B513CE23FD56D56



Task 1: Deriving the Private Key

For our simplicity we choose 128-bit values,

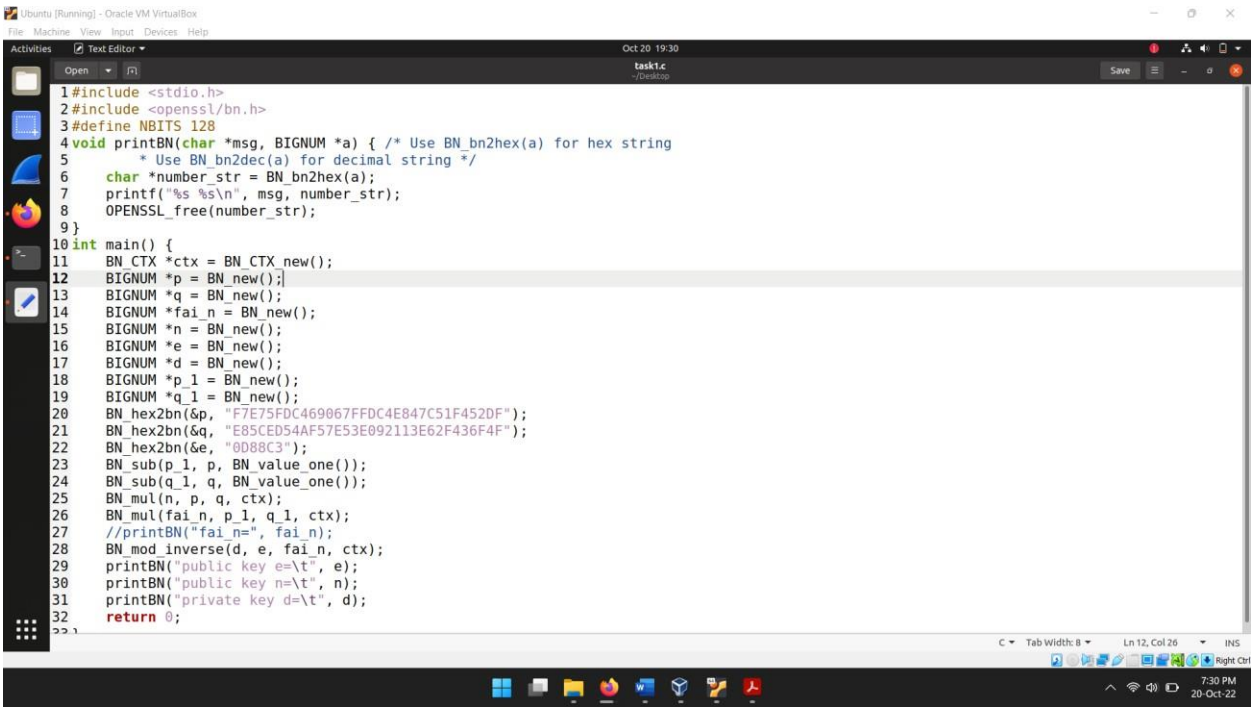
Let p = F7E75FDC469067FFDC4E847C51F452DF

q = E85CED54AF57E53E092113E62F436F4F

e = 0D88C3

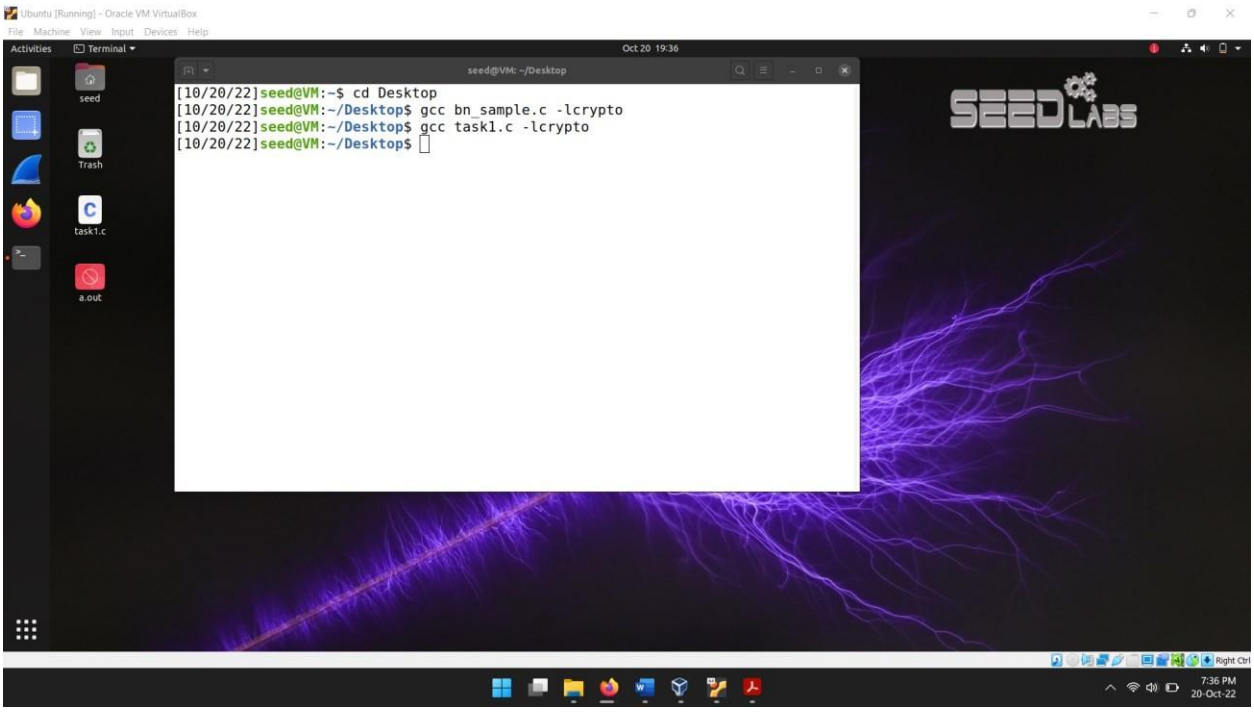
from previous Big Number Task we get to know an idea about how can we get our private key d when *p,q,e* and *n(p*q)* are given already. We will use (e,n) as a public key. Here we have hexadecimal value of ***p,q and e***, our ***d*** will also be in hexadecimal value.

We named our file ***task1.c*** which we created through Text Editor in Ubuntu VM, below is the code which you can see it below.



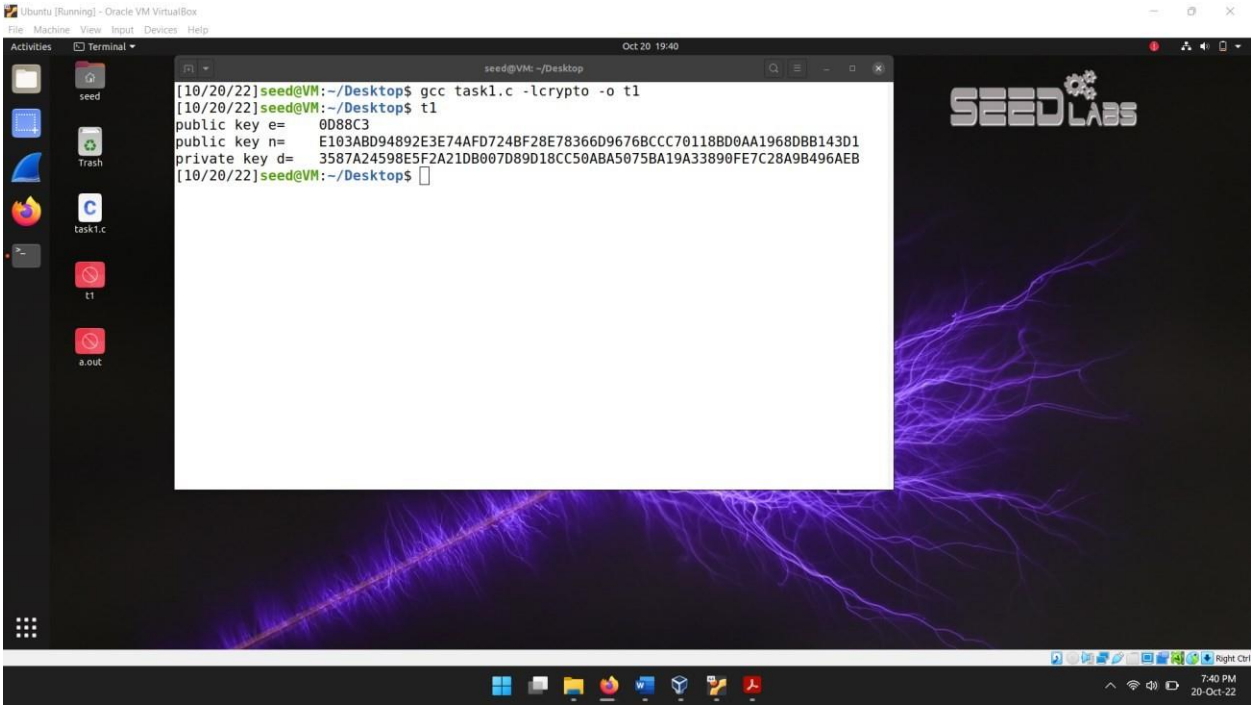
Now we compile it using Terminal and by entering command:

gcc task1.c -lcrypto



Our file got compiled successfully, now we run it by command:

gcc task1.c -lcrypto -o t1
t1



We got the value of

public key e= 0D88C3

public key n=
E103ABD94892E3E74AFD724BF28E78366D9676BCCC70118BD0AA1968DBB143D1

private key d=
3587A24598E5F2A21DB007D89D18CC50ABA5075BA19A33890FE7C28A9B496AEB

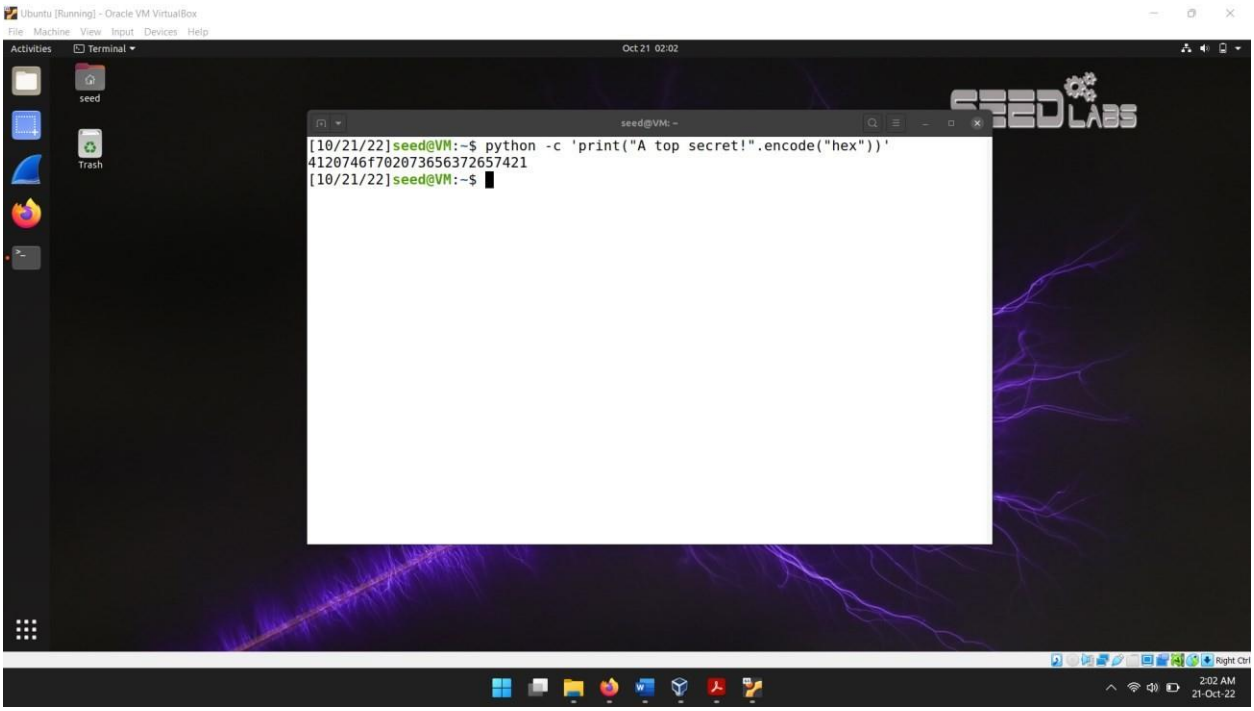
Task 2: Encrypting a Message

Message to encrypt are ‘‘A top secret!" without quotes, first we convert ASCII in hex string by the ***python*** command:

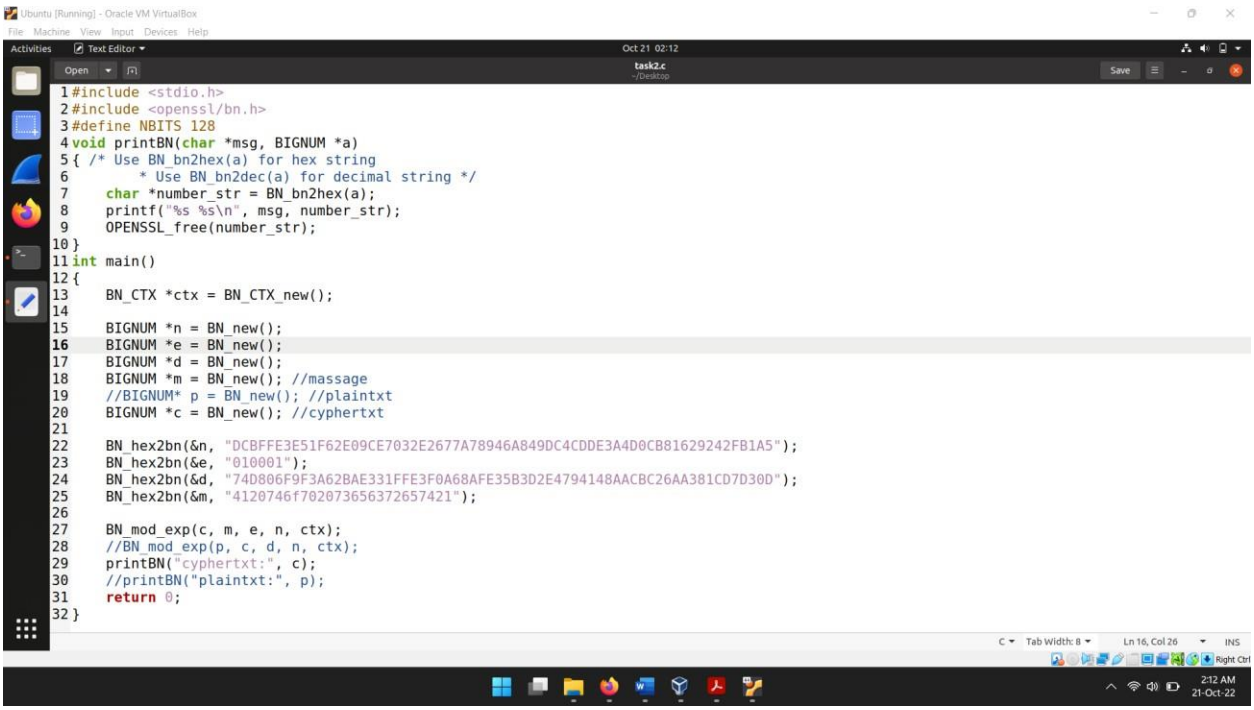
python -c 'print("A top secret!".encode("hex"))'

The hex string, we got are:

4120746f702073656372657421



Now its time to convert hex string to BigNum using hex to bn Api. For that we wrote a code in C language using Text Editor and named it task2.c



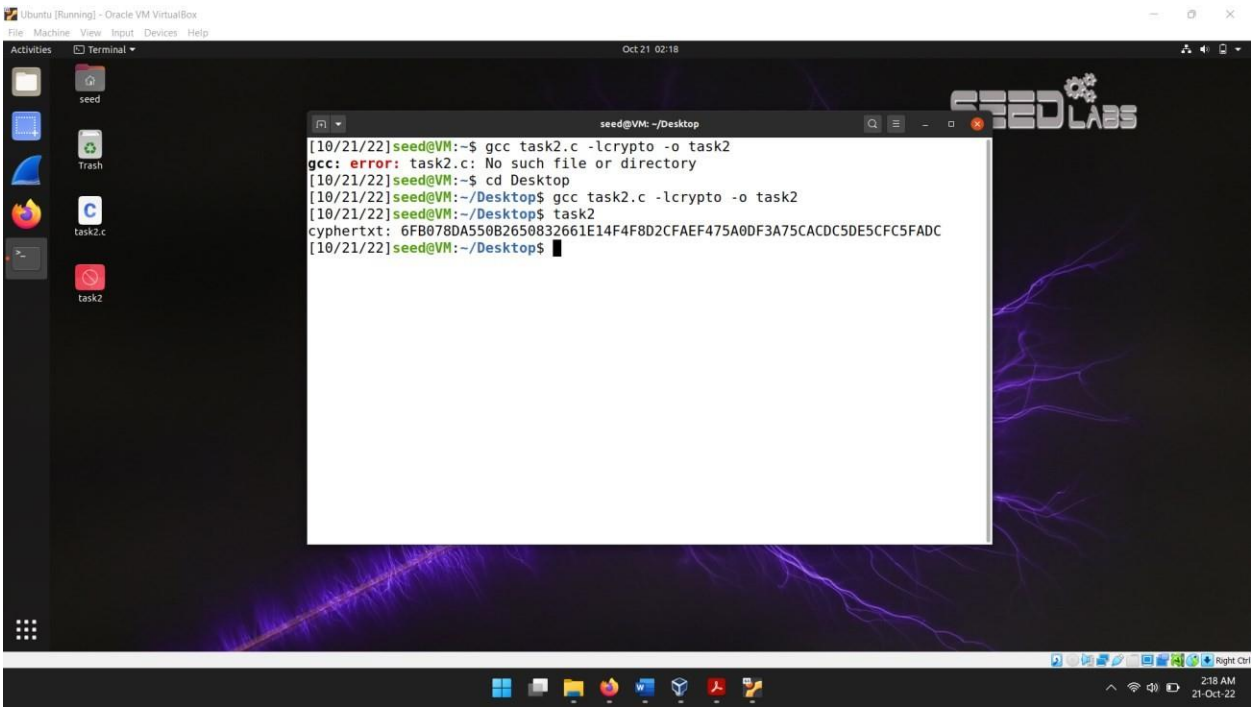
To see our encrypted text, we compiled and run it by

gcc task2.c -lcrypto -o task2

task2

we got out encrypted text that is

cyphertxt:
6FB078DA550B2650832661E14F4F8D2CFAEF475A0DF3A75CACDC5DE5CFC5FADC



Task 3: Decrypting a Message

Cypher text to decrypt is
“8C0F971DF2F3672B28811407E2DABBE1DA0FEBBBDFC7DCB67396567EA1E2493F”
(without quotes)

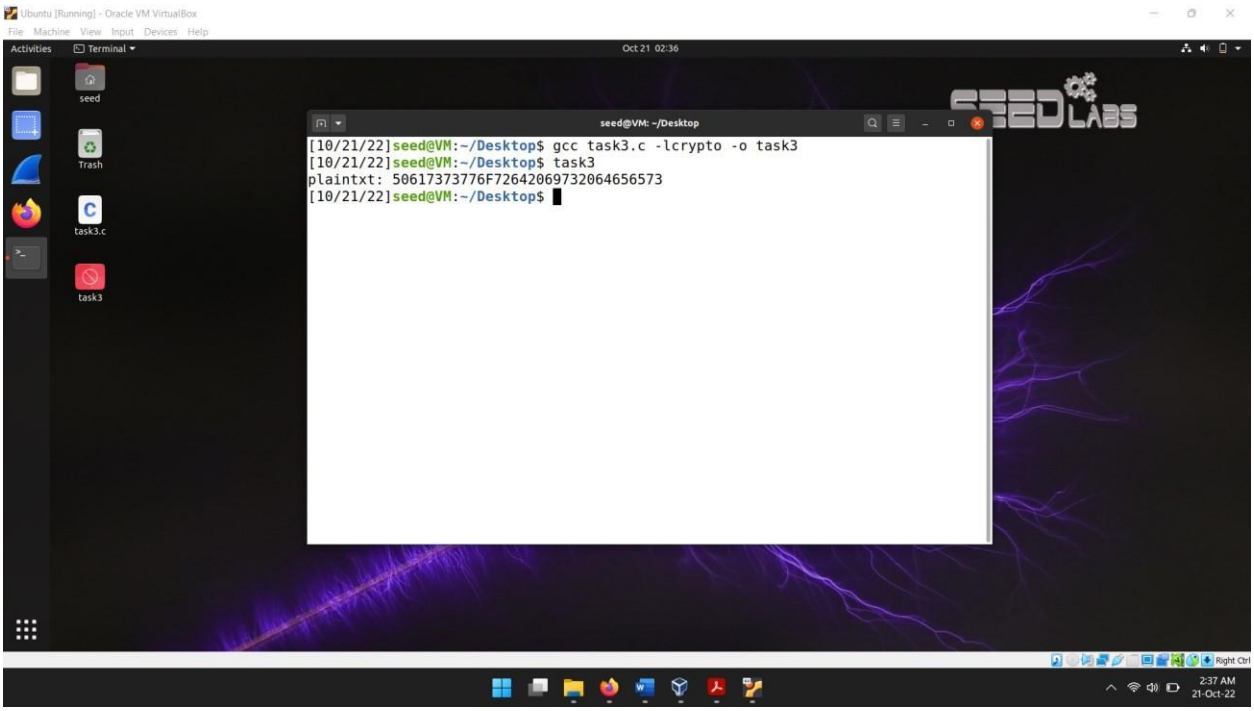
Keys are same which we used in previous task, first we code in text editor which you can see in below image and save it as ***task3.c*** then run by command:

gcc task3.c -lcrypto -o task3

task3

In output we got following result,

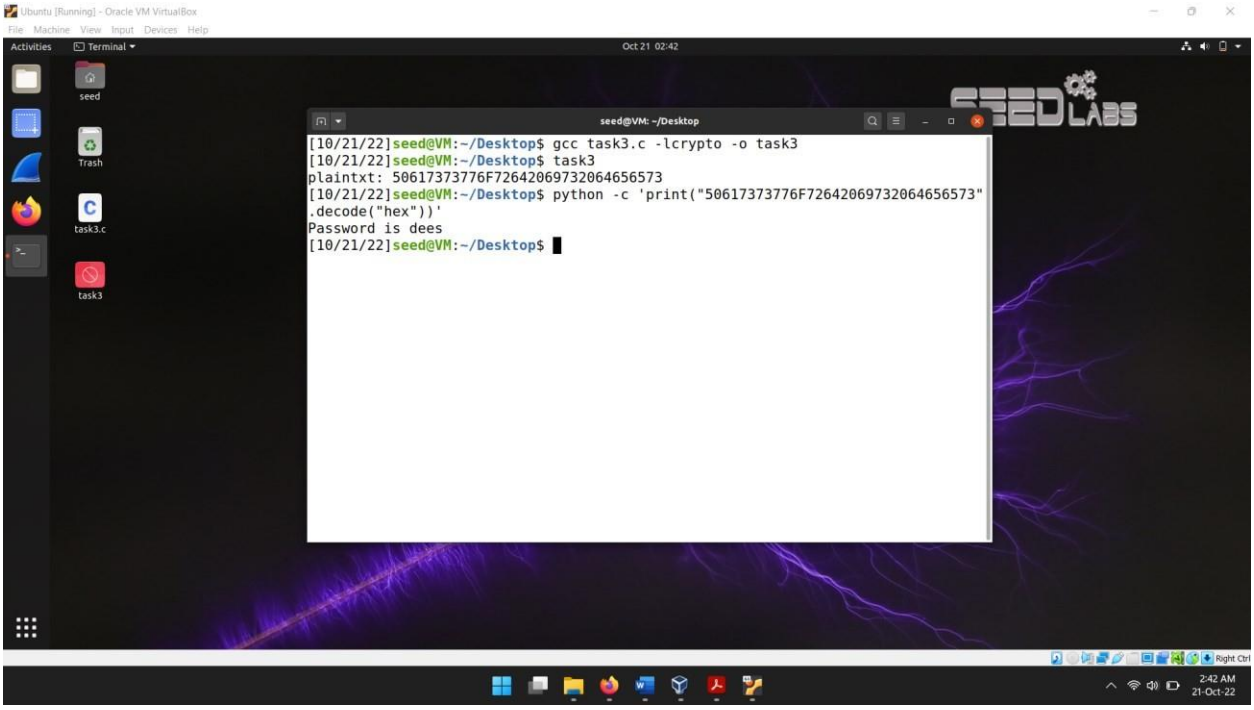
plaintxt: 50617373776F72642069732064656573



Now decrypt hex to ASCII using python script

python -c 'print("50617373776F72642069732064656573".decode("hex"))'

The result we got in ASCII is: Password is dees



Task 4: Signing a Message

Message one: I owe you $2000.

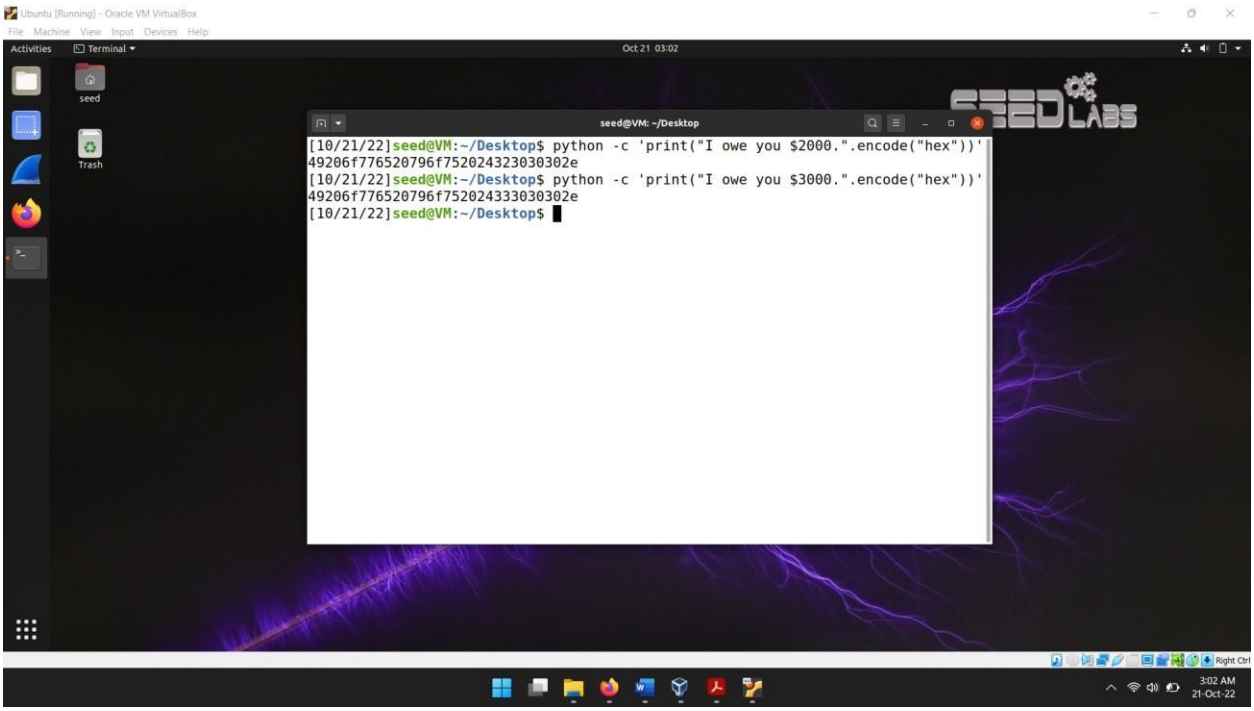
Message two: I owe you $3000.

Private and Public keys are same used in Task 2

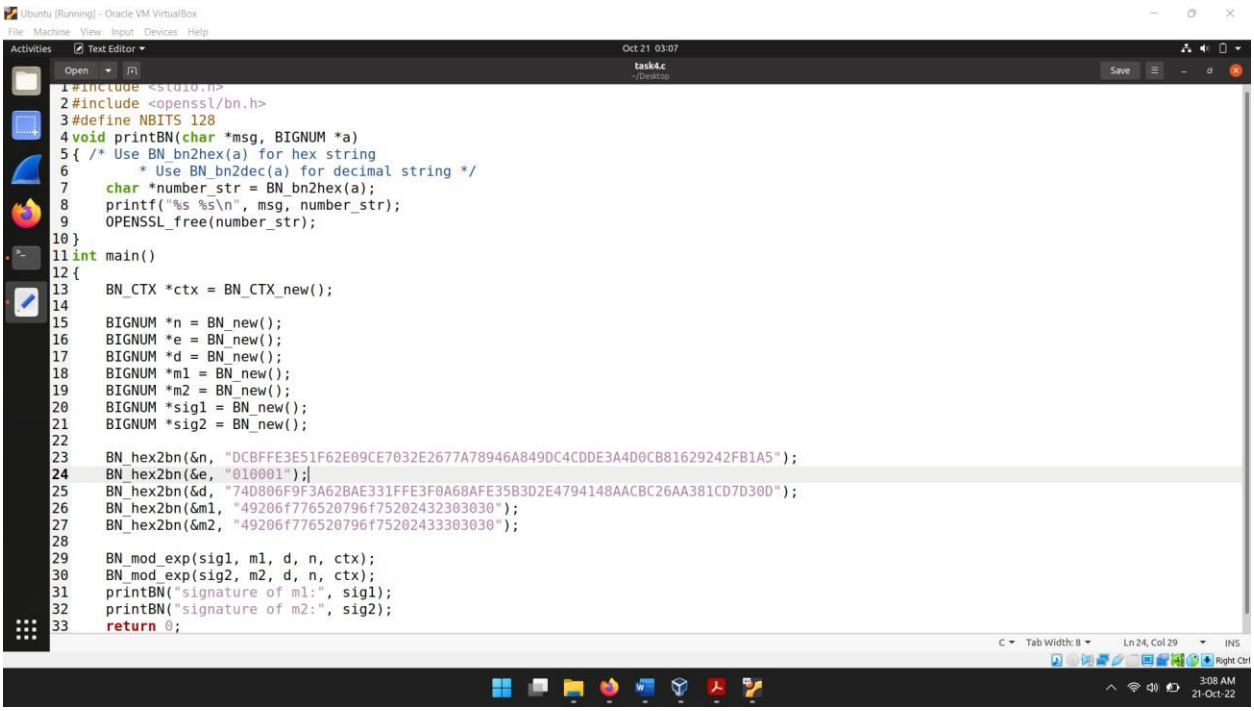
To generate signature for above messages we first of all get the hex value of the ASCII strings through python command and in return we got following value.

Hexa one: 49206f776520796f752024323030302e

Hexa two: 49206f776520796f752024333030302e



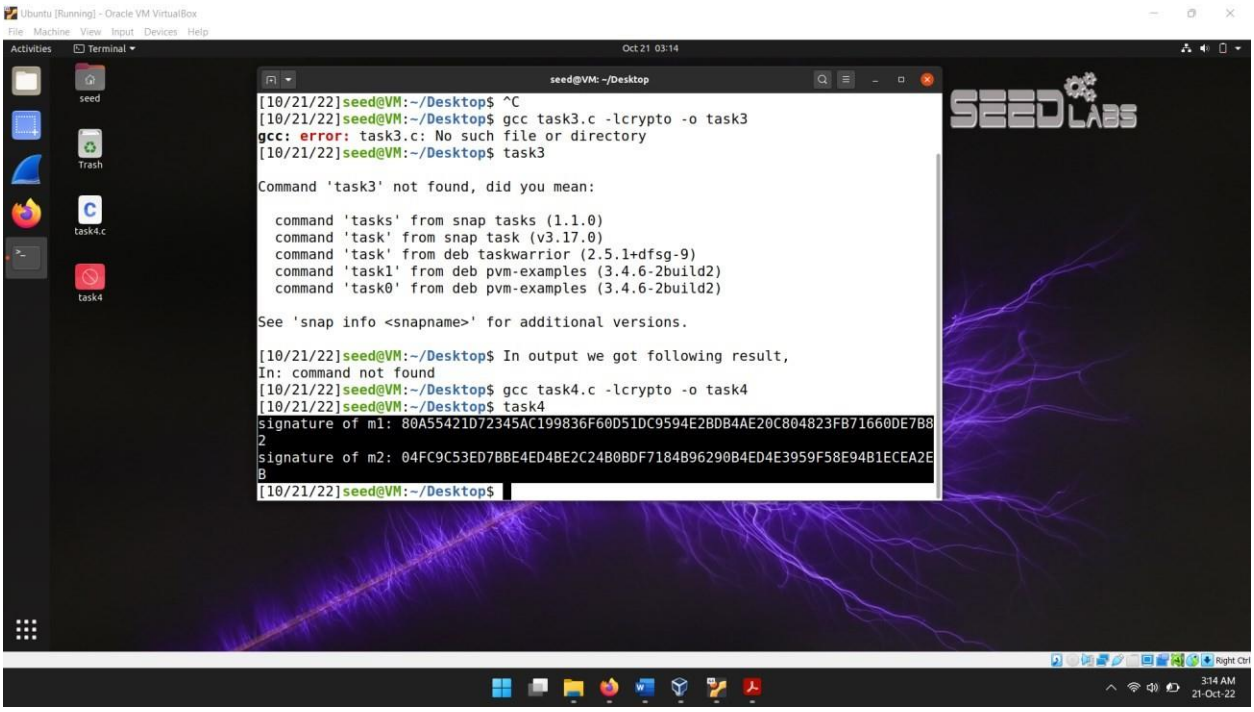
We sign direct message instead of signing the message hash for that purpose wrote C code in text editor and save it as ***task4.c***.



We run command ***gcc task4.c -lcrypto -o task4***

task4

In output we got following result on terminal,



Result:

signature of m1:
80A55421D72345AC199836F60D51DC9594E2BDB4AE20C804823FB71660DE7B82

signature of m2:
04FC9C53ED7BBE4ED4BE2C24B0BDF7184B96290B4ED4E3959F58E94B1ECEA2EB

Even we done small change but the result is totally different.

Task 5: Verifying a Signature

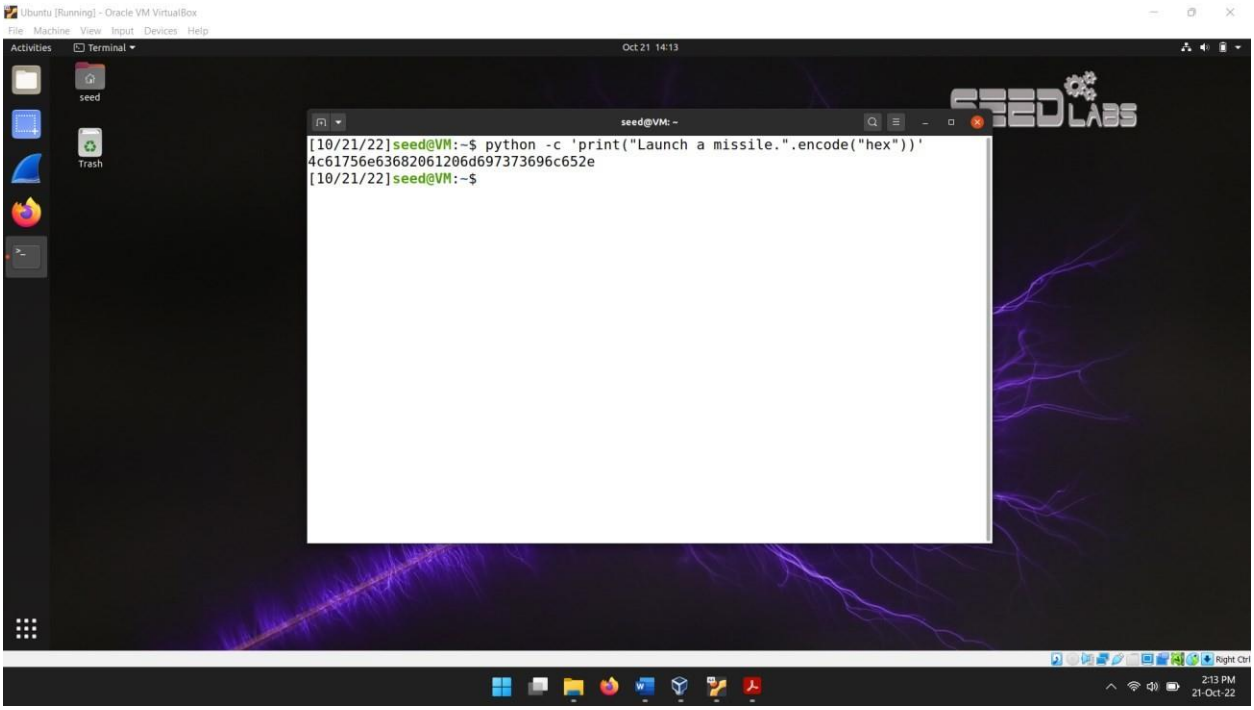
Message = M = Launch a missile.

Convert ASCII string to hexadecimal in Terminal by using command

python -c 'print("Launch a missile.".encode("hex"))'

we got following hexadecimal value:

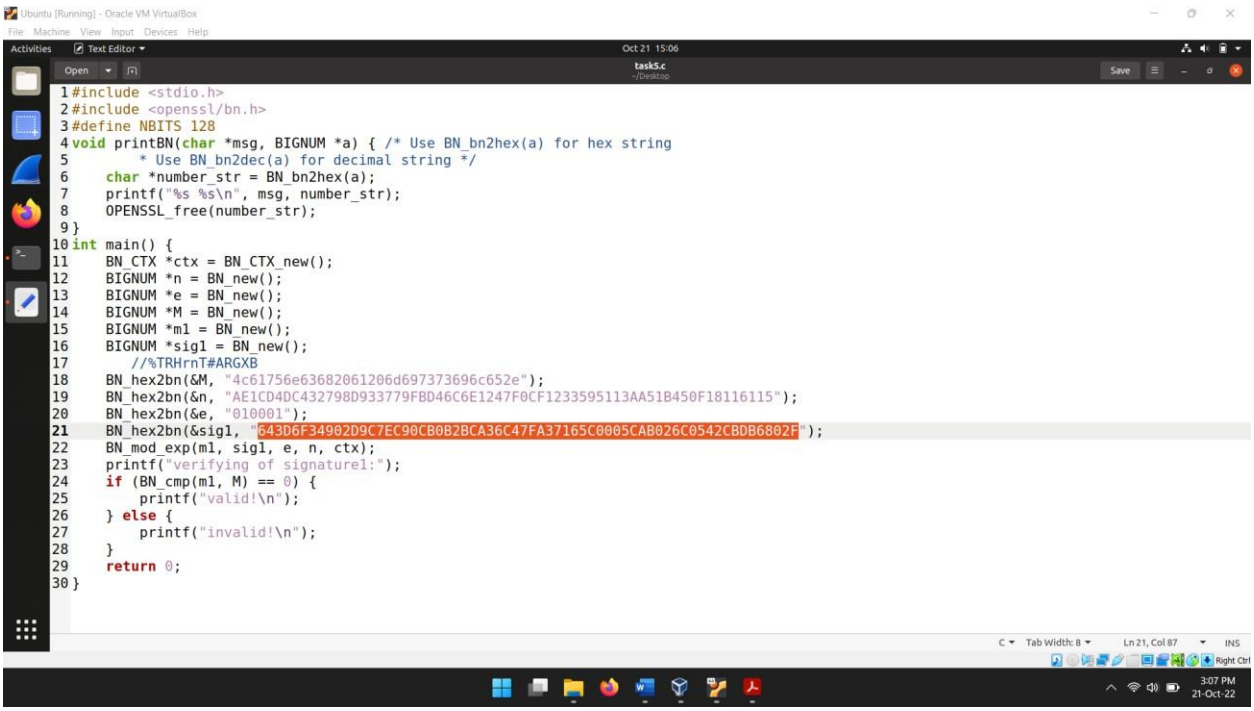
4c61756e63682061206d697373696c652e



Now we code in C language to verify the signature *S* that it belongs to Alice or not in text editor and saved the file with name ***task5.c***, values of public key, message and signature are available to us in hexadecimal. Below is the screenshot of the code.

In below code we used signature value as,

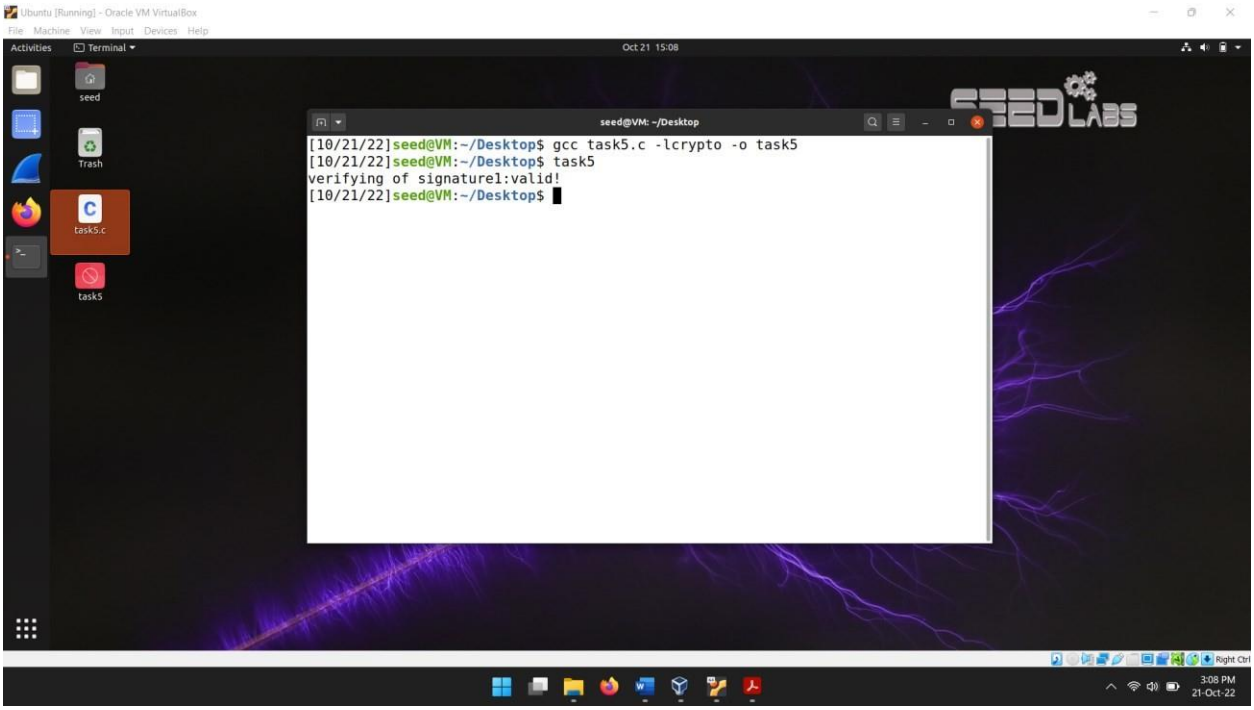
643D6F34902D9C7EC90CB0B2BCA36C47FA37165C0005CAB026C0542CBDB6802F



```c
#include <stdio.h>
#include <openssl/bn.h>
#define NBITS 128
void printBN(char *msg, BIGNUM *a) { /* Use BN_bn2hex(a) for hex string
        * Use BN_bn2dec(a) for decimal string */
    char *number_str = BN_bn2hex(a);
    printf("%s %s\n", msg, number_str);
    OPENSSL_free(number_str);
}
int main() {
    BN_CTX *ctx = BN_CTX_new();
    BIGNUM *n = BN_new();
    BIGNUM *e = BN_new();
    BIGNUM *M = BN_new();
    BIGNUM *m1 = BN_new();
    BIGNUM *sig1 = BN_new();
       //%TRHrnT#ARGXB
    BN_hex2bn(&M, "4c61756e63682061206d697373696c652e");
    BN_hex2bn(&n, "AE1CD4DC432798D933779FBD46C6E1247F0CF1233595113AA51B450F18116115");
    BN_hex2bn(&e, "010001");
    BN_hex2bn(&sig1, "643D6F34902D9C7EC90CB0B2BCA36C47FA37165C0005CAB026C0542CBDB6802F");
    BN_mod_exp(m1, sig1, e, n, ctx);
    printf("verifying of signature1:");
    if (BN_cmp(m1, M) == 0) {
        printf("valid!\n");
    } else {
        printf("invalid!\n");
    }
    return 0;
}
```

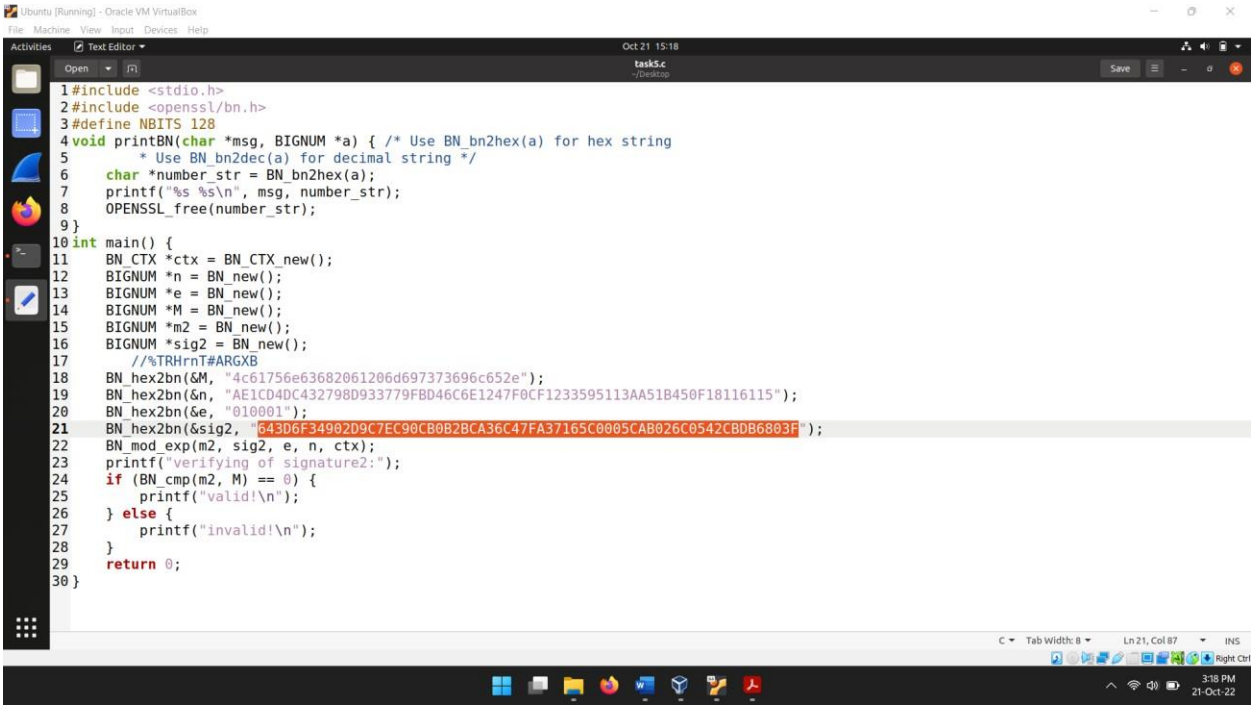
Compile this code in terminal by using command, ***gcc task5.c -lcrypto -o task5*** and then run the program to check the validity of signature by command ***task5***. In output we can see the result that it is valid signature because we got following output.

verifying of signature1:valid!



Let us assume that the last byte of signature got changed from *2F* to *3F* so the signature got corrupted by only bit. To verify the changes, we repeat all previous steps to know what we get in result.

Sig2: 643D6F34902D9C7EC90CB0B2BCA36C47FA37165C0005CAB026C0542CBDB6803F

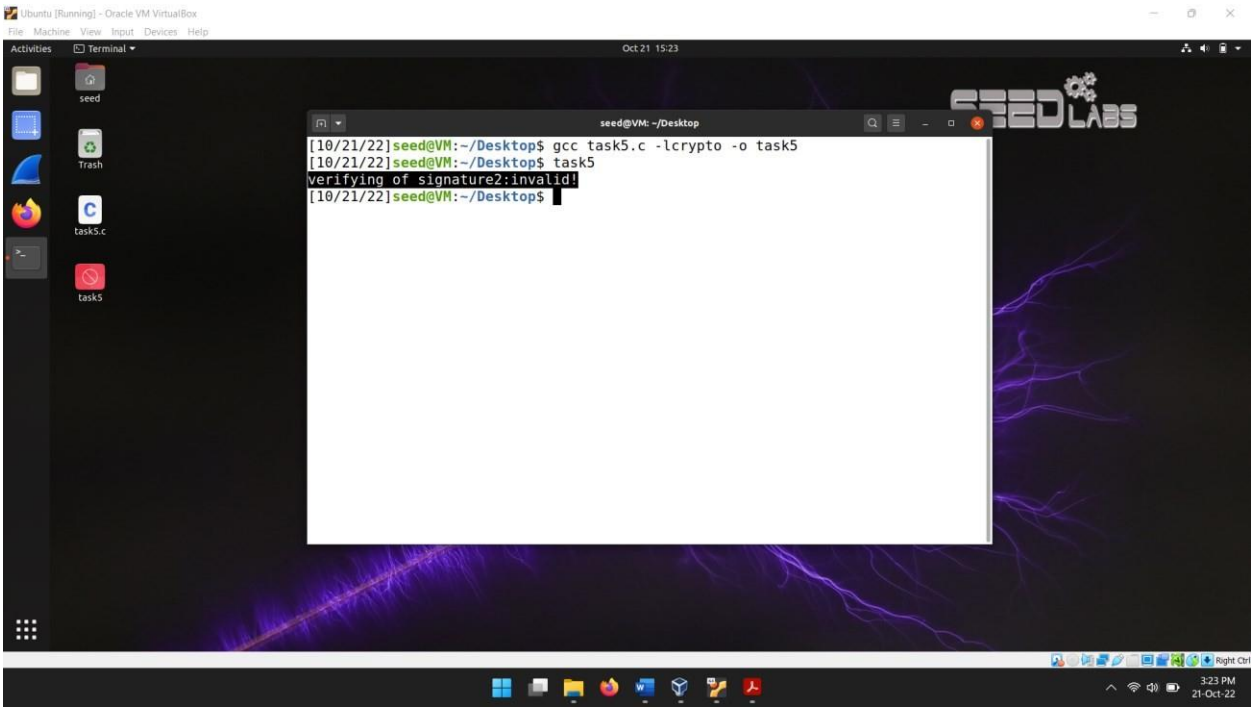


We recompile and run the program by commands:

gcc task5.c -lcrypto -o task5

task5

and got response as ***verifying of signature2:invalid!*** which can be seen below image. From this we can conclude that even if one bit is changed our whole signature will be totally changed. Due to that our signature got invalid.

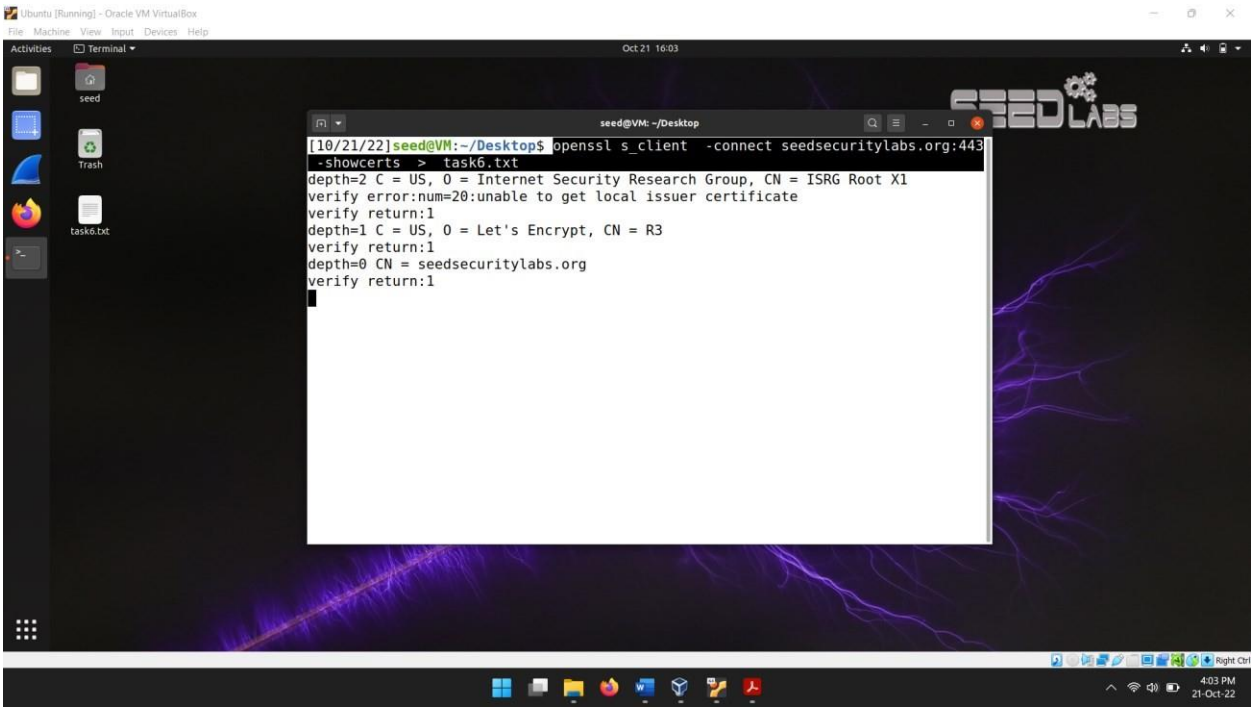


Task 6: Manually Verifying an X.509 Certificate

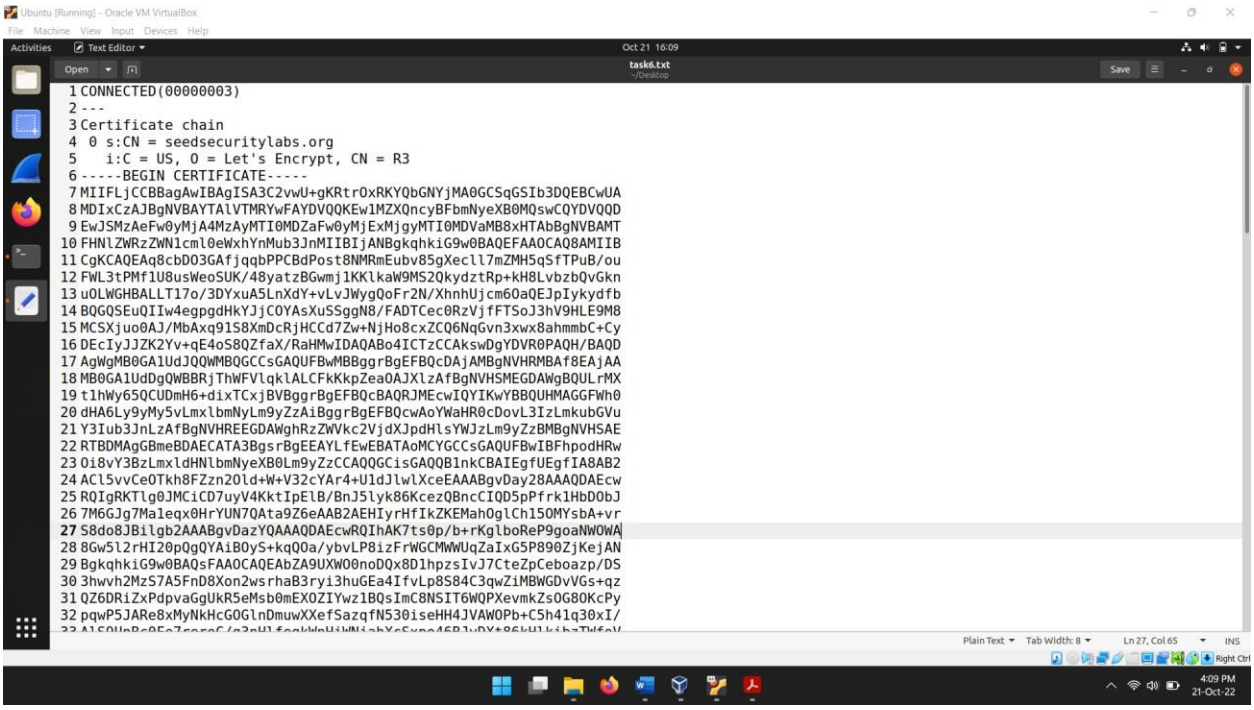
Step 1: Download a certificate from a real web server.

For this task we use URL https://seedsecuritylabs.org/ as an example, we first download the certificate from web server and saved in ***task6.txt*** by command

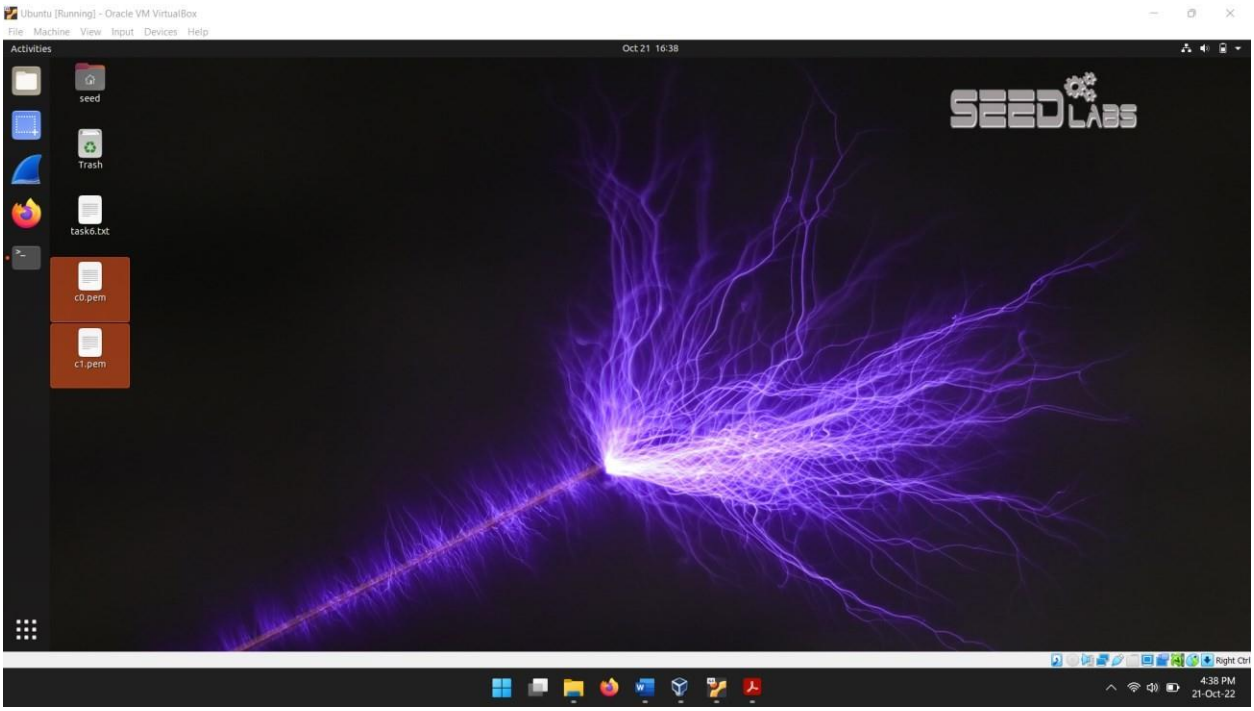
openssl s_client -connect seedsecuritylabs.org:443 -showcerts > task6.txt



Certificates are founded in ***task6.txt*** file which we download and exported in ***task6.txt*** earlier



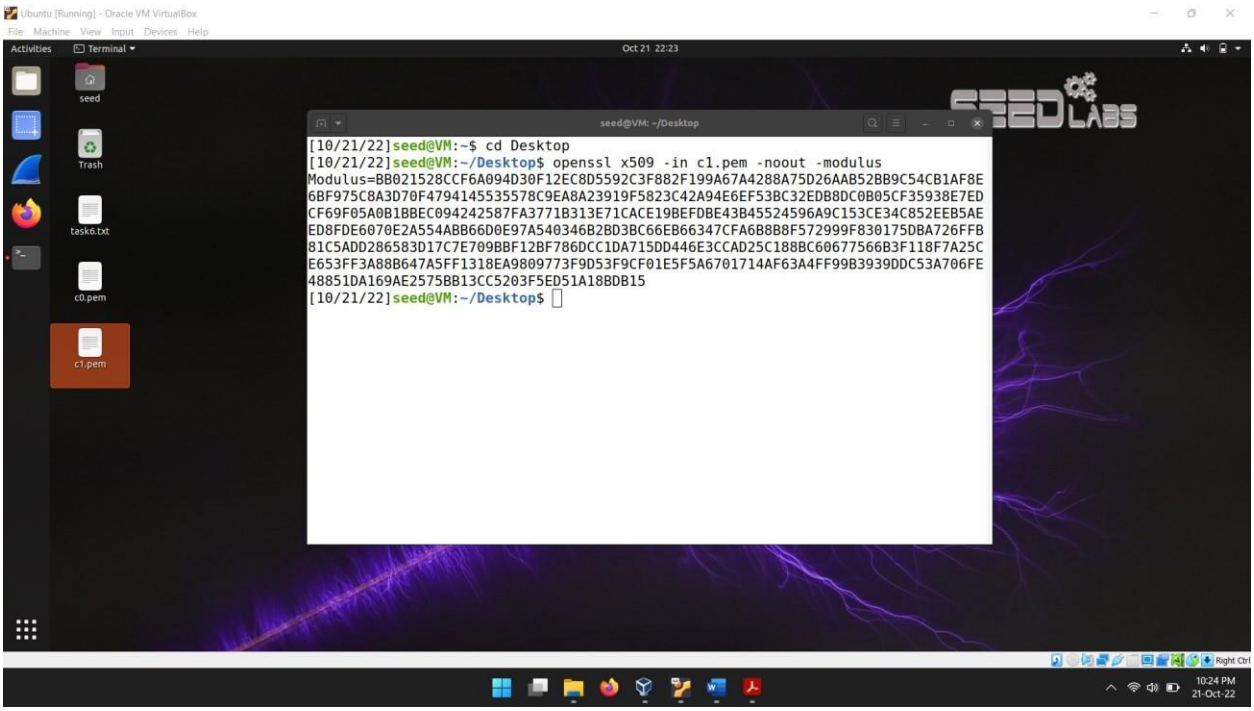
Save first certificate as c0.pem and second c1.pem



Step 2: Extract the public key **(e, n)** from the issuer's certificate.

We extract value of *n* using -modulus with openssl command and that is,

openssl x509 -in c1.pem -noout -modulus

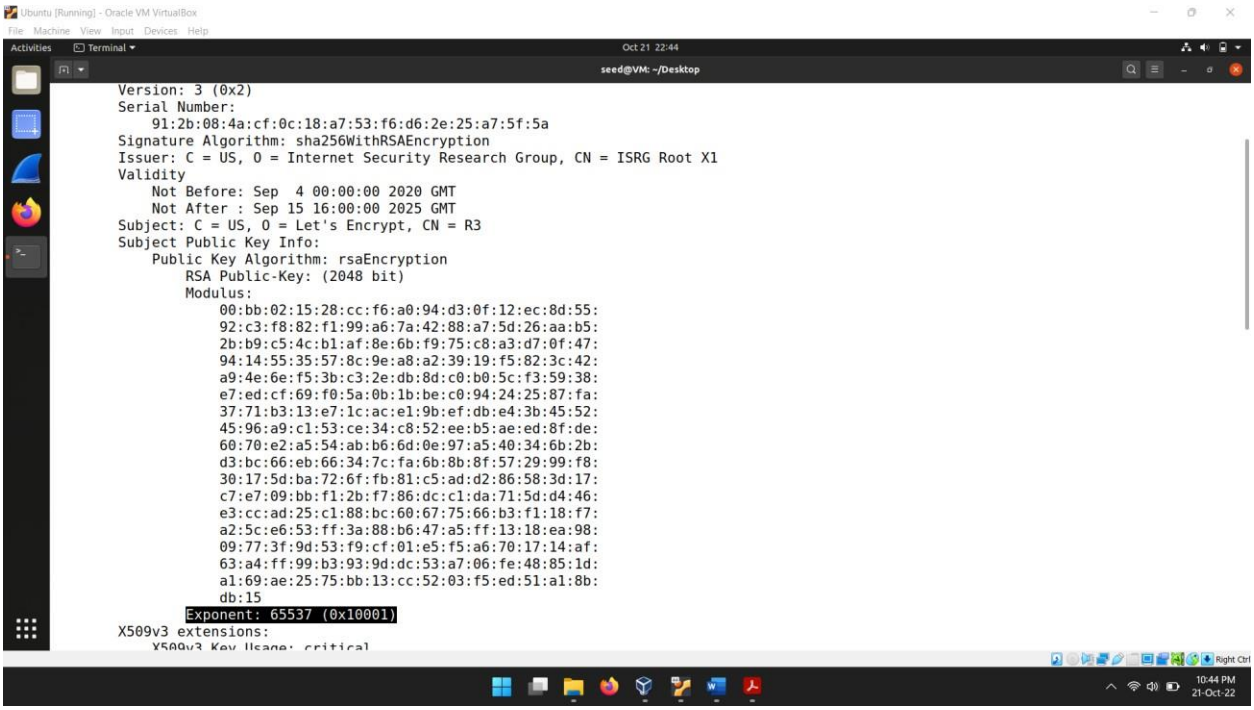


n =
BB021528CCF6A094D30F12EC8D5592C3F882F199A67A4288A75D26AAB52BB9C54CB1
AF8E6BF975C8A3D70F4794145535578C9EA8A23919F5823C42A94E6EF53BC32EDB8DC0
B05CF35938E7EDCF69F05A0B1BBEC094242587FA3771B313E71CACE19BEFDBE43B455
24596A9C153CE34C852EEB5AEED8FDE6070E2A554ABB66D0E97A540346B2BD3BC66E
B66347CFA6B8B8F572999F830175DBA726FFB81C5ADD286583D17C7E709BBF12BF786
DCC1DA715DD446E3CCAD25C188BC60677566B3F118F7A25CE653FF3A88B647A5FF131
8EA9809773F9D53F9CF01E5F5A6701714AF63A4FF99B3939DDC53A706FE48851DA169A
E2575BB13CC5203F5ED51A18BDB15

We cannot extract e but we can tell the way that can easily find *e*.

By using following command, we can find *e* (exponential)

openssl x509 -in c1.pem -text -noout



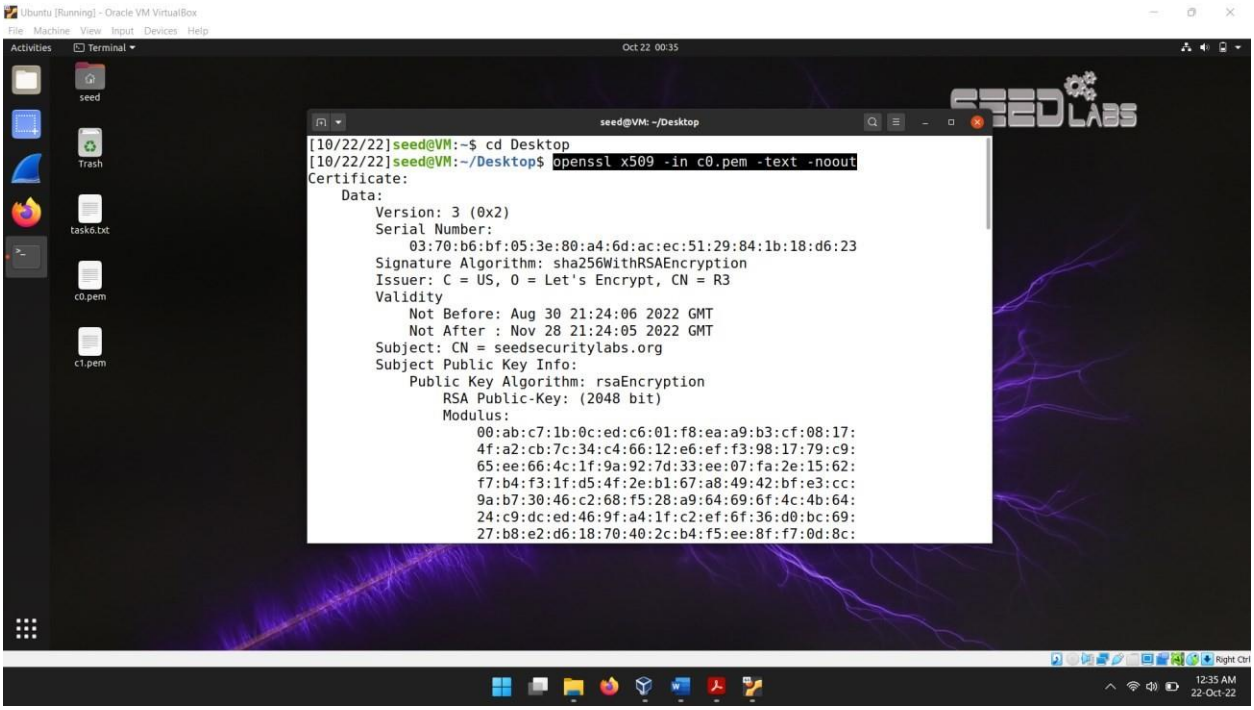
We printed all values of certificate first and then get our exponent(e) which is equal to **65537 (0x10001)**

Step 3: Extract the signature from the server's certificate.

To extract signature from certificate we need to print out all fields first then we copy the signature block and paste it in our file because there is no specific command to extract signature.

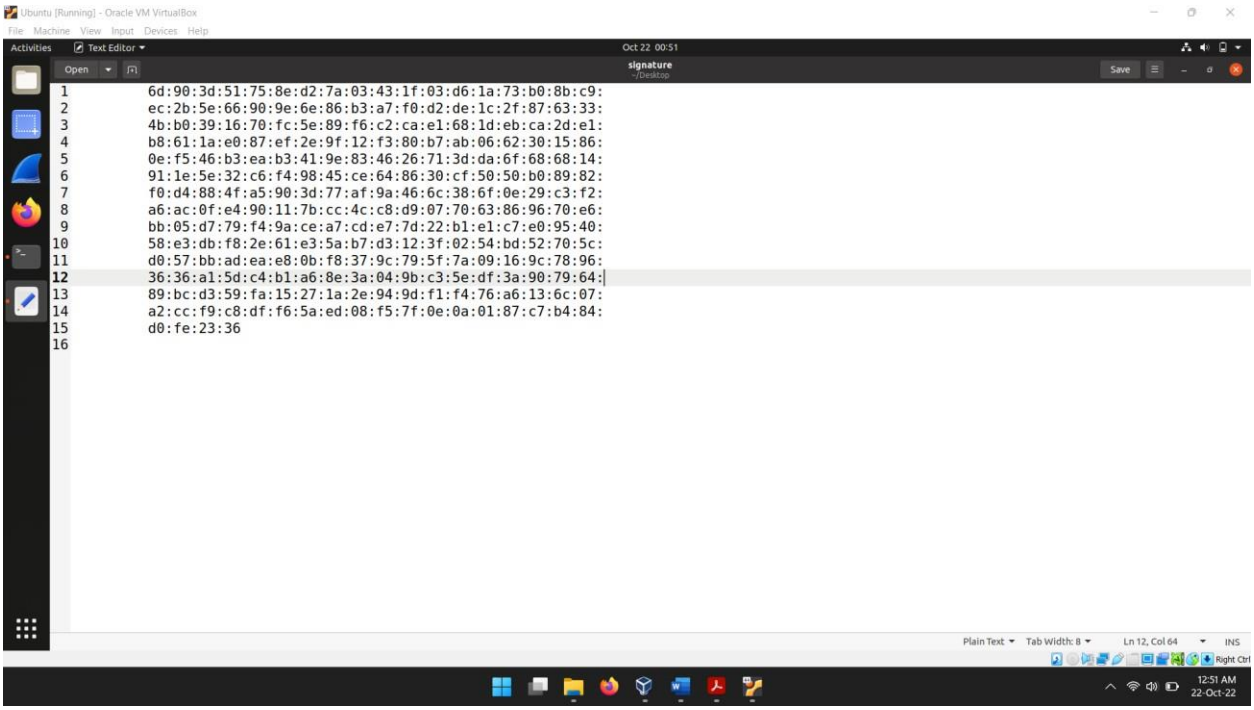
We used command in terminal to print all attributes are

openssl x509 -in c0.pem -text -noout



We got our data but there is one issue that it has colons and spaces to remove them there is a command in linux utility for string manipulation, *tr* and “space” and “:” can be remove by *-d* option.

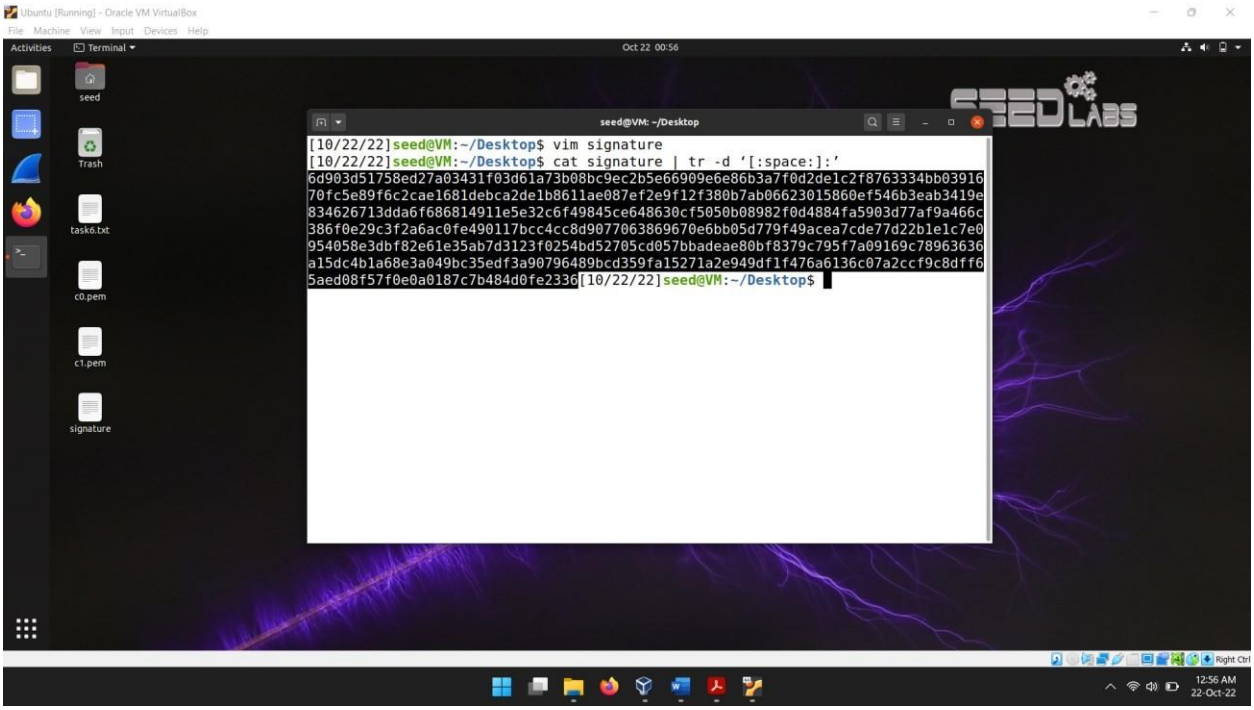
For this we first save our signature body in a file called signature.



Run following commands in terminal

vim signature

cat signature | tr -d '[:space:]:'

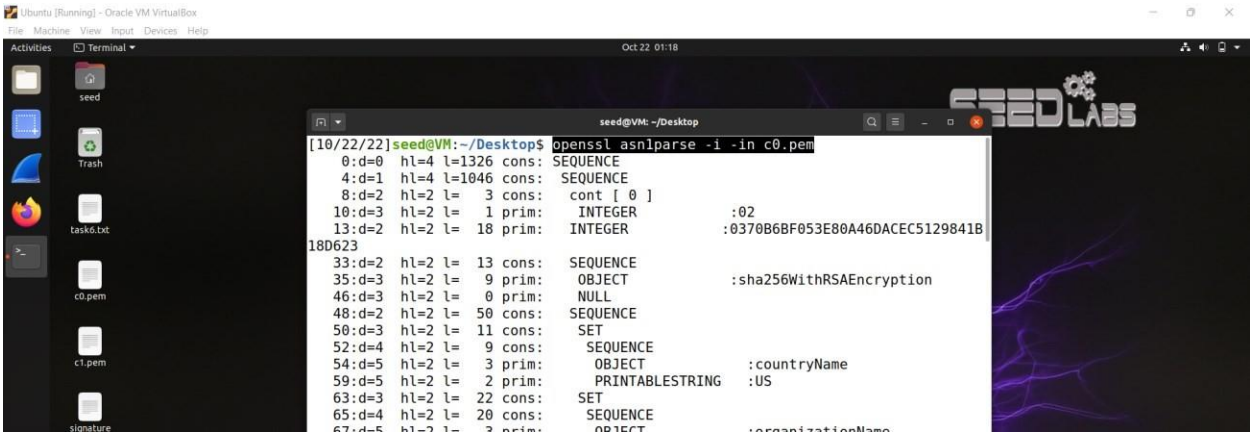


Here we can see we get our signature without colon and space.

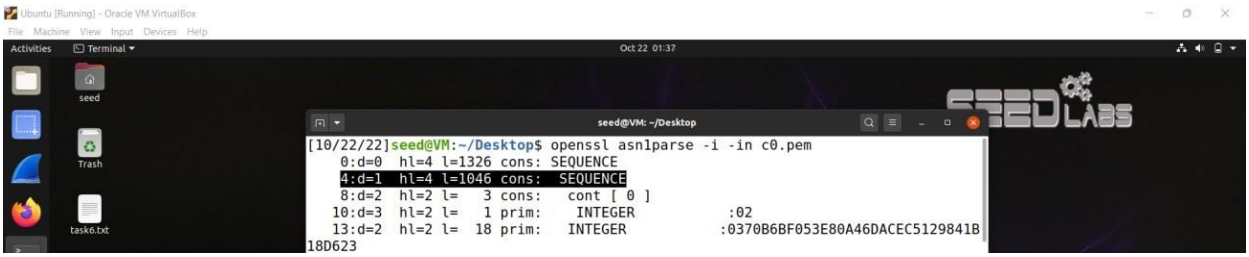
Step 4: Extract the body of the server's certificate.

First of all, we parse the ASN.1 structure by using *openssl* command *asn1parse* to get data from ASN.1

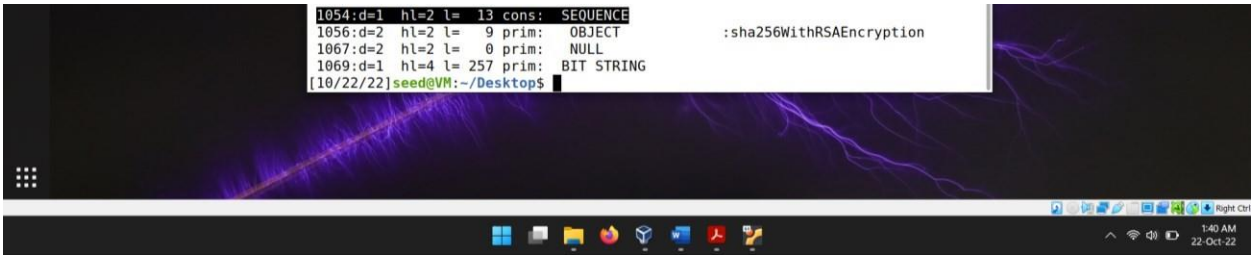
openssl asn1parse -i -in c0.pem



The first highlighted field is the body of the certificate used to generate the hash,



The second highlighted image is the signature block.



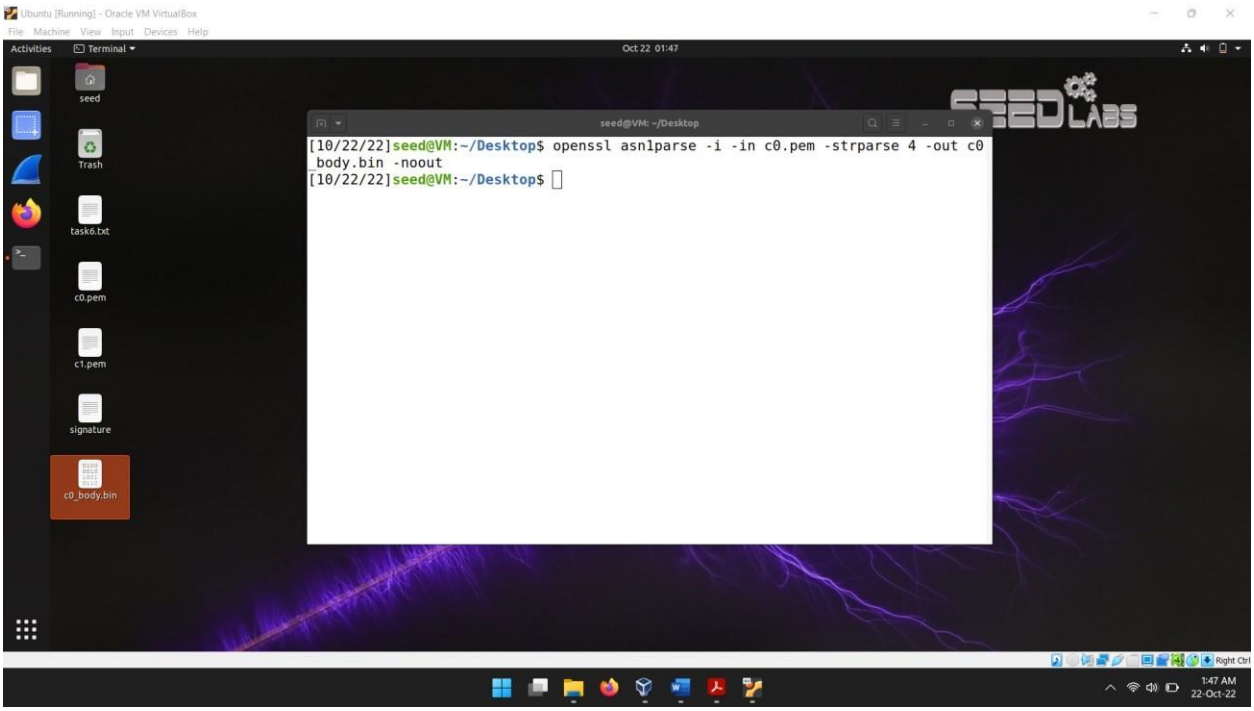
Their certificate offsets are 4 to 1053, while their signature offset is from 1054 to end of file.

In X.509 certificates starting will be same for all and that is 4 but ending will be depend on content length.

We can get body of certificate without signature block with the help of *-strparse* command,

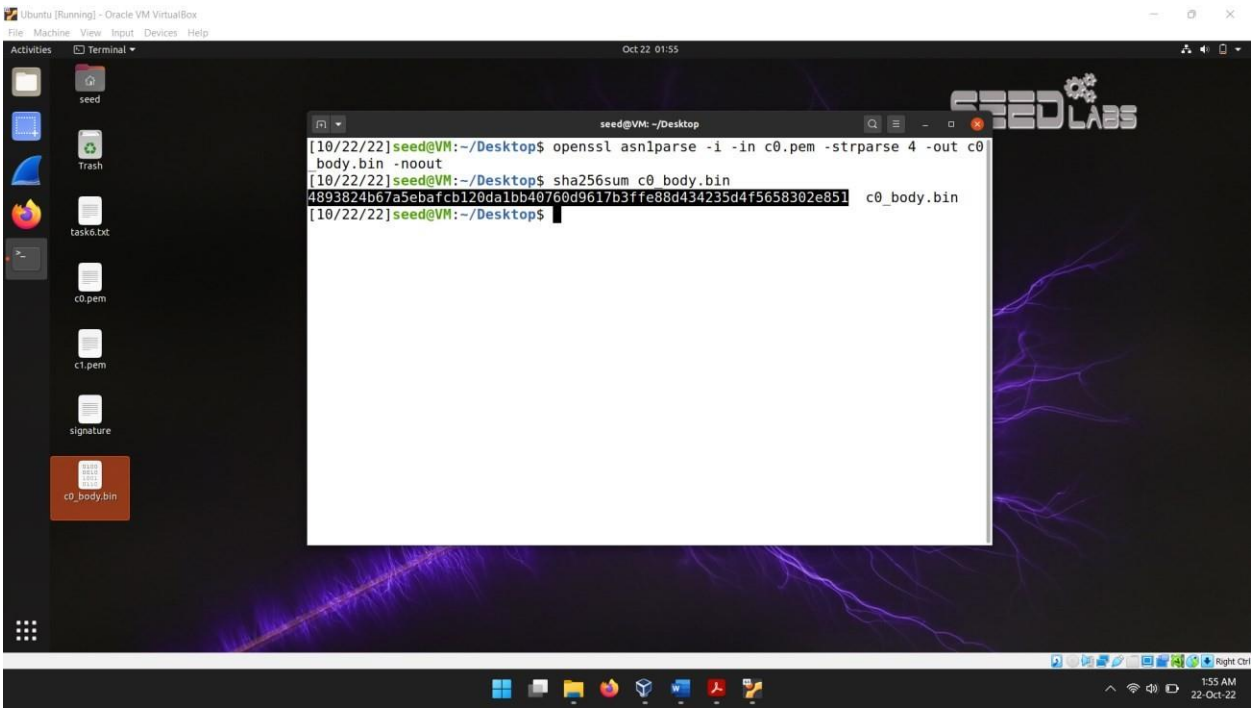
There is a file created which can be seen in below image with command:

openssl asn1parse -i -in c0.pem -strparse 4 -out c0_body.bin -noout



Now to calculate its hash value we run command:

sha256sum c0_body.bin



Its hash value is 4893824b67a5ebafcb120da1bb40760d9617b3ffe88d434235d4f5658302e851

Step 5: Verify the signature.

To verify that our signature is valid or not we run our own program in C language.

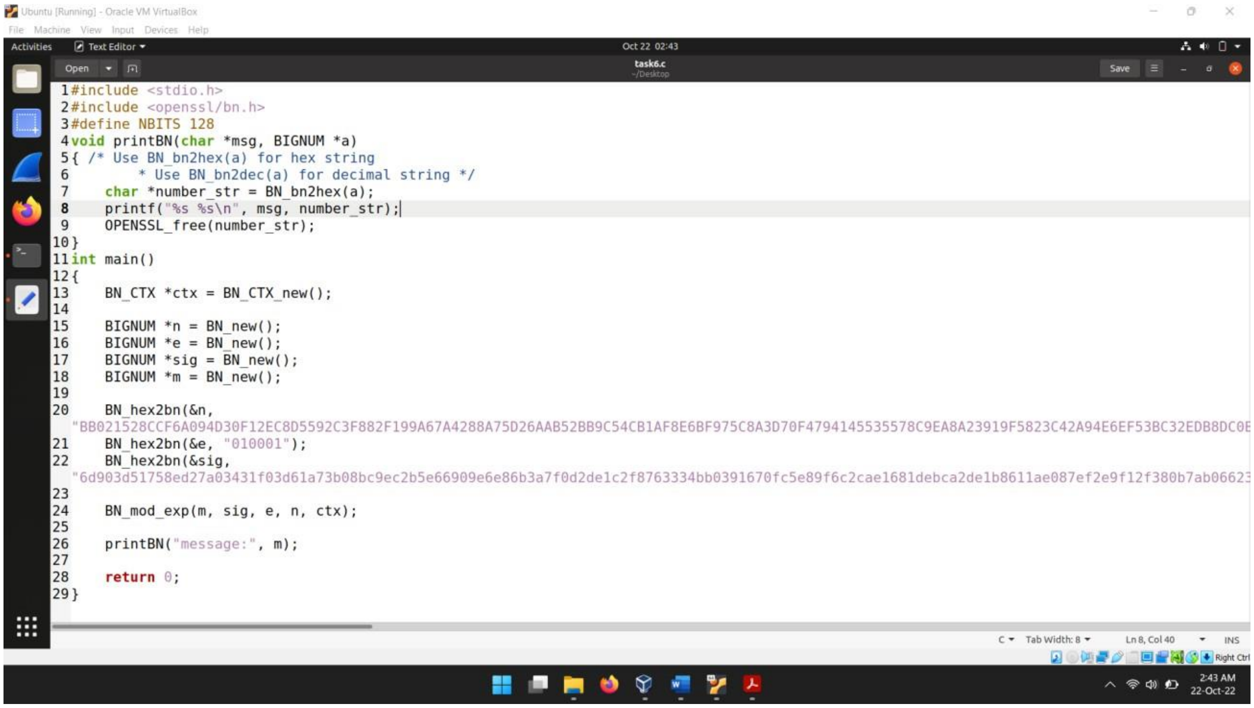
For that we first extract our Message *M*,

we have following values:

n =
BB021528CCF6A094D30F12EC8D5592C3F882F199A67A4288A75D26AAB52BB9C54CB1
AF8E6BF975C8A3D70F4794145535578C9EA8A23919F5823C42A94E6EF53BC32EDB8DC0
B05CF35938E7EDCF69F05A0B1BBEC094242587FA3771B313E71CACE19BEFDBE43B455
24596A9C153CE34C852EEB5AEED8FDE6070E2A554ABB66D0E97A540346B2BD3BC66E
B66347CFA6B8B8F572999F830175DBA726FFB81C5ADD286583D17C7E709BBF12BF786
DCC1DA715DD446E3CCAD25C188BC60677566B3F118F7A25CE653FF3A88B647A5FF131
8EA9809773F9D53F9CF01E5F5A6701714AF63A4FF99B3939DDC53A706FE48851DA169A
E2575BB13CC5203F5ED51A18BDB15

e = 010001

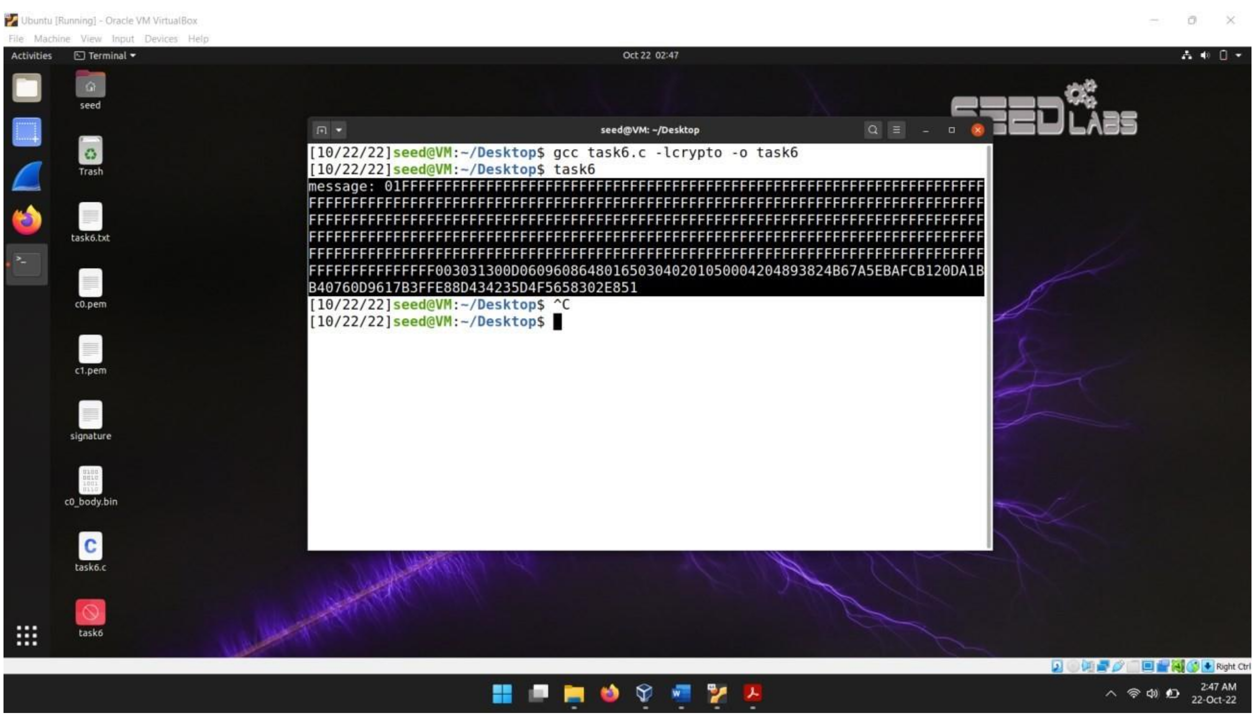
s =
6d903d51758ed27a03431f03d61a73b08bc9ec2b5e66909e6e86b3a7f0d2de1c2f8763334bb03916
70fc5e89f6c2cae1681debca2de1b8611ae087ef2e9f12f380b7ab06623015860ef546b3eab3419e83
4626713dda6f686814911e5e32c6f49845ce648630cf5050b08982f0d4884fa5903d77af9a466c386
f0e29c3f2a6ac0fe490117bcc4cc8d9077063869670e6bb05d779f49acea7cde77d22b1e1c7e09540
58e3dbf82e61e35ab7d3123f0254bd52705cd057bbadeae80bf8379c795f7a09169c78963636a15d
c4b1a68e3a049bc35edf3a90796489bcd359fa15271a2e949df1f476a6136c07a2ccf9c8dff65aed08
f57f0e0a0187c7b484d0fe2336



We save the code in text editor by naming it *task6.c*, compile and run the code in terminal by using following commands:

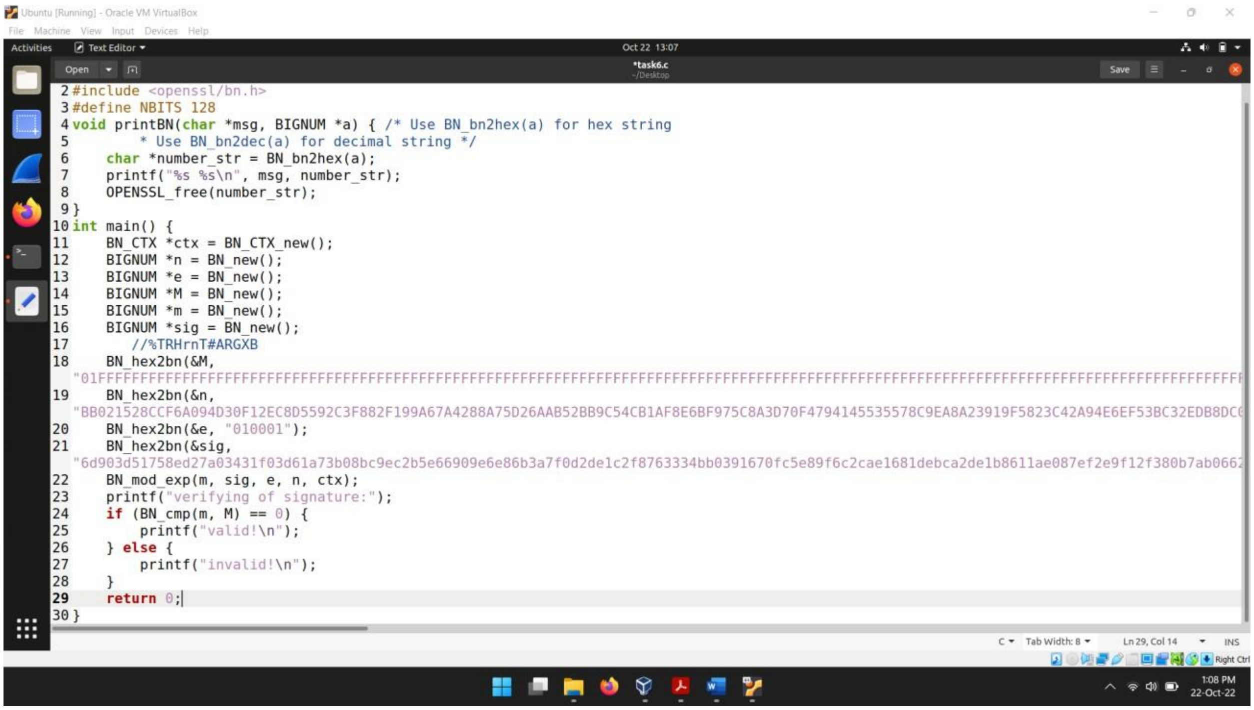
gcc task6.c -lcrypto -o task6

task6



We got our Message M:
01FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF
FFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFFF003031300D06096
086480165030402010500042048938824B67A5EBAFCB120DA1BB40760D9617B3FFE88D434
235D4F5658302E851

After that we edit our C code which we wrote earlier, our code looks like this now.



Now we compile and run our program using command:

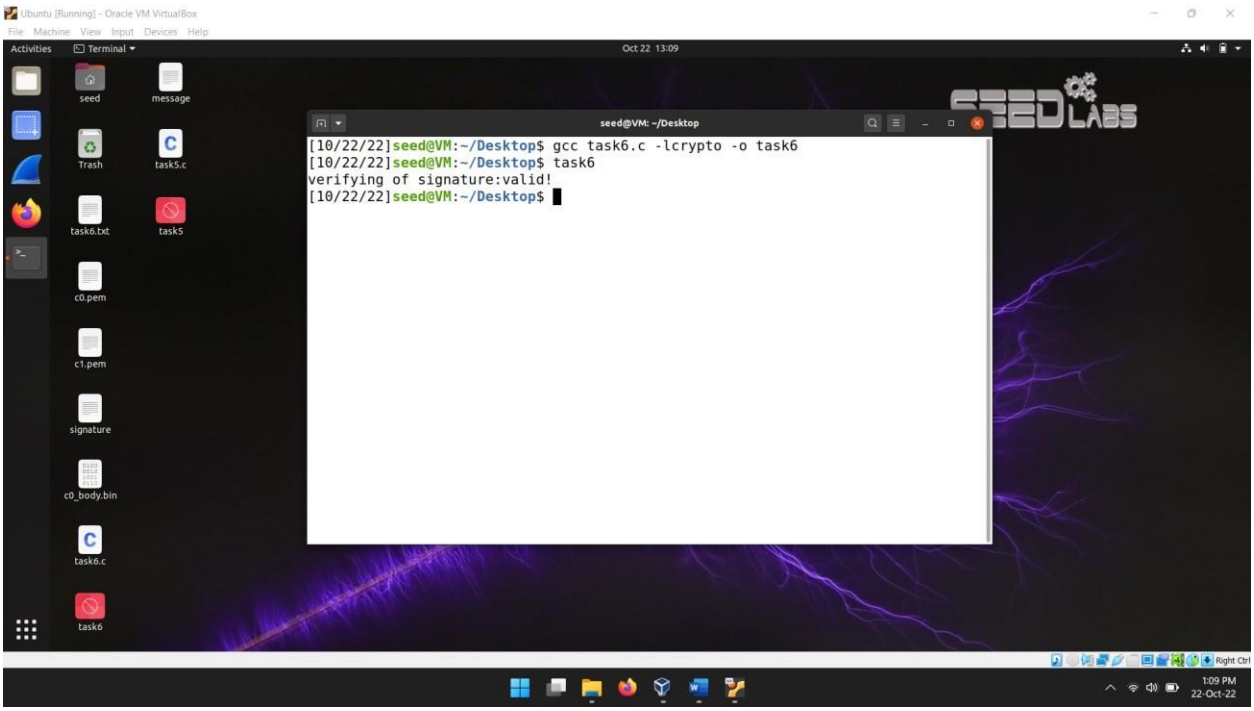
gcc task6.c -lcrypto -o task6

task6

In response we got output as

verifying of signature:valid!

The image below is confirming that our signature is valid.


Ubuntu [Running] - Oracle VM VirtualBox
File Machine View Input Devices Help
Activities
Terminal
Oct 22 13:09
seed
message
Trash
task5.c
task6.txt
task5
c0.pem
c1.pem
signature
c0_body.bin
task6.c
task6
seed@VM: ~/Desktop
[10/22/22]seed@VM:~/Desktop$ gcc task6.c -lcrypto -o task6
[10/22/22]seed@VM:~/Desktop$ task6
verifying of signature:valid!
[10/22/22]seed@VM:~/Desktop$
SEED LABS
Right Ctrl
1:09 PM
22-Oct-22