Author: Kyle Machalec

Execution:

a. What is Kali's main interface's MAC address? (The main interface is probably called eth0, but check ifconfig to be sure.)
   i. 00:0c:29:98:6a:a8
b. What is Kali's main interface's IP address?
   i. 192.168.234.128
c. What is Metasploitable's main interface's MAC address?
   i. 00:0c:29:b1:2d:39
d. What is Metasploitable's main interface's IP address?
   i. 192.168.234.129
e. Show Kali's routing table. (Use "netstat -r" to see it with symbolic names, or "netstat -rn" to see it with numerical addresses.)

```
┌──(kali㉿kali)-[~/Downloads]
└─$ netstat -r
Kernel IP routing table
Destination     Gateway         Genmask         Flags   MSS Window  irtt Iface
default         192.168.234.2   0.0.0.0         UG        0 0          0 eth0
192.168.234.0   0.0.0.0         255.255.255.0   U         0 0          0 eth0
```

f. Show Kali's ARP cache. (Use "arp" or "arp -n".)

```
┌──(kali㉿kali)-[~/Downloads]
└─$ arp
Address                  HWtype  HWaddress           Flags Mask            Iface
192.168.234.254          ether   00:50:56:e8:0d:50   C                     eth0
192.168.234.2            ether   00:50:56:f4:7a:e1   C                     eth0
```

g. Show Metasploitable's routing table.

```
msfadmin@metasploitable:~$ netstat -r
Kernel IP routing table
Destination     Gateway         Genmask         Flags   MSS Window  irtt Iface
192.168.234.0   *               255.255.255.0   U         0 0          0 eth0
default         192.168.234.2   0.0.0.0         UG        0 0          0 eth0
```

h. Show Metasploitable's ARP cache.

```
msfadmin@metasploitable:~$ arp
Address                  HWtype  HWaddress           Flags Mask            Iface
192.168.234.2            ether   00:50:56:F4:7A:E1   C                     eth0
192.168.234.128          ether   00:0C:29:98:6A:A8   C                     eth0
```

i. Suppose the user of Metasploitable wants to get the CS338 sandbox page via the command "curl http://cs338.jeffondich.com/". To which MAC address should Metasploitable send the TCP SYN packet to get the whole HTTP query started? Explain why.
   i. By checking in the Metasploitable routing table, you can find the IP address of the “gateway” to the internet, which would be 192.168.234.2 in this case. This gateway is the first destination of the TCP SYN packet. Then, in the

Metasploitable ARP cache, you can look for the MAC address associated with the IP address of the gateway, which is 00:50:56:F4:7A:E1.

j. Fire up Wireshark on Kali. Start capturing packets for "tcp port http". On Metasploitable, execute "curl http://cs338.jeffondich.com/". On Kali, stop capturing. Do you see an HTTP response on Metasploitable? Do you see any captured packets in Wireshark on Kali?
   i. I can see an HTTP response on Metasploitable, which is the HTML source code of http://cs338.jeffondich.com/. I do not see any captured packets in Wireshark on Kali.

k. Now, it's time to be Mal (who will, today, merely eavesdrop). Use Ettercap to do ARP spoofing (also known as ARP Cache Poisoning) with Metasploitable as your target. There are many online tutorials on how to do this (here's one). Find one you like, and start spoofing your target. NOTE: most of these tutorials are showing an old user interface for Ettercap, which may make them confusing. The steps you're trying to take within Ettercap are:
   i. Start sniffing (not bridged sniffing) on eth0
   ii. Scan for Hosts
   iii. View the Hosts list
   iv. Select your Metasploit VM from the Host List
   v. Add that host as Target 1
   vi. Start ARP Poisoning (including Sniff Remote Connections)
   vii. Do your stuff with wireshark and Metasploitable
   viii. Stop ARP Poisoning

   DONE

l. Show Metasploitable's ARP cache. How has it changed?

192.168.234.254 and 192.168.234.1 have been added to the ARP cache. All of the MAC addresses have been changed to Kali's MAC address (00:0c:29:98:6a:a8)

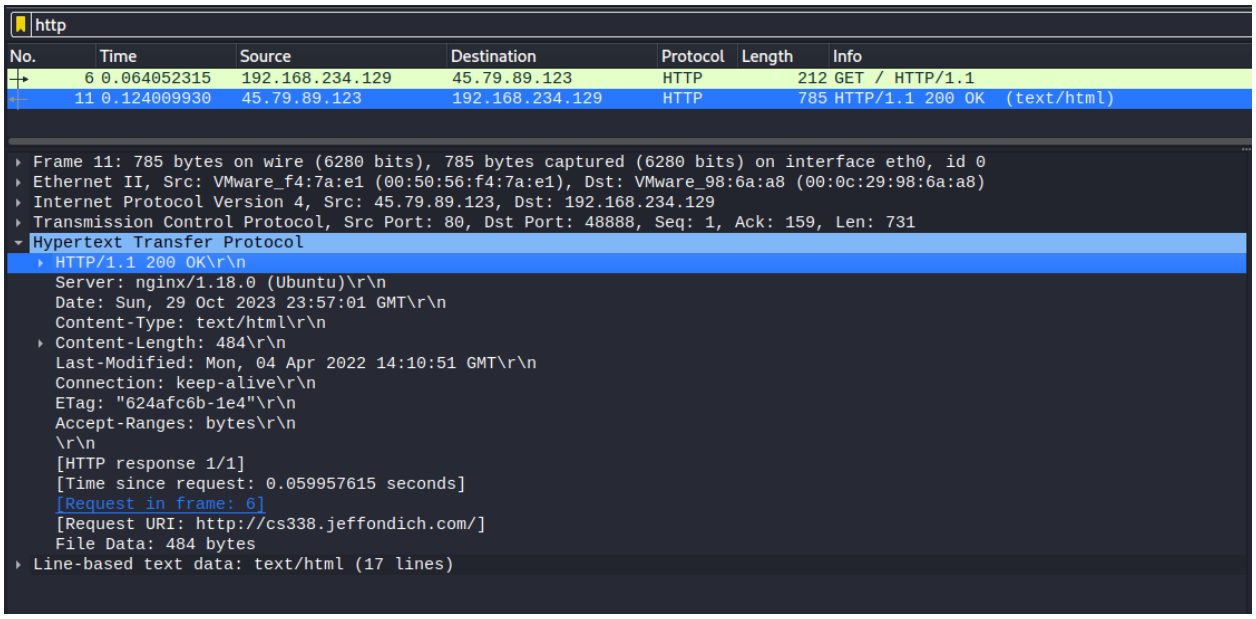
```
msfadmin@metasploitable:~$ arp
Address                  HWtype  HWaddress           Flags Mask            Iface
192.168.234.1            ether   00:0C:29:98:6A:A8   C                     eth0
192.168.234.254          ether   00:0C:29:98:6A:A8   C                     eth0
192.168.234.2            ether   00:0C:29:98:6A:A8   C                     eth0
192.168.234.128          ether   00:0C:29:98:6A:A8   C                     eth0
```

m. Without actually doing it yet, predict what will happen if you execute "curl http://cs338.jeffondich.com/" on Metasploitable now. Specifically, to what MAC address will Metasploitable send the TCP SYN packet? Explain why.
   i. I predict that Metasploitable will send the TCP SYN packet to Kali's MAC address (00:0c:29:98:6a:a8). This is because Metasploitable's ARP cache replaced the gateway's MAC address with Kali's MAC address, effectively letting Kali place itself in the middle between Metasploitable and the gateway.

n. Start Wireshark capturing "tcp port http" again.
   i. DONE

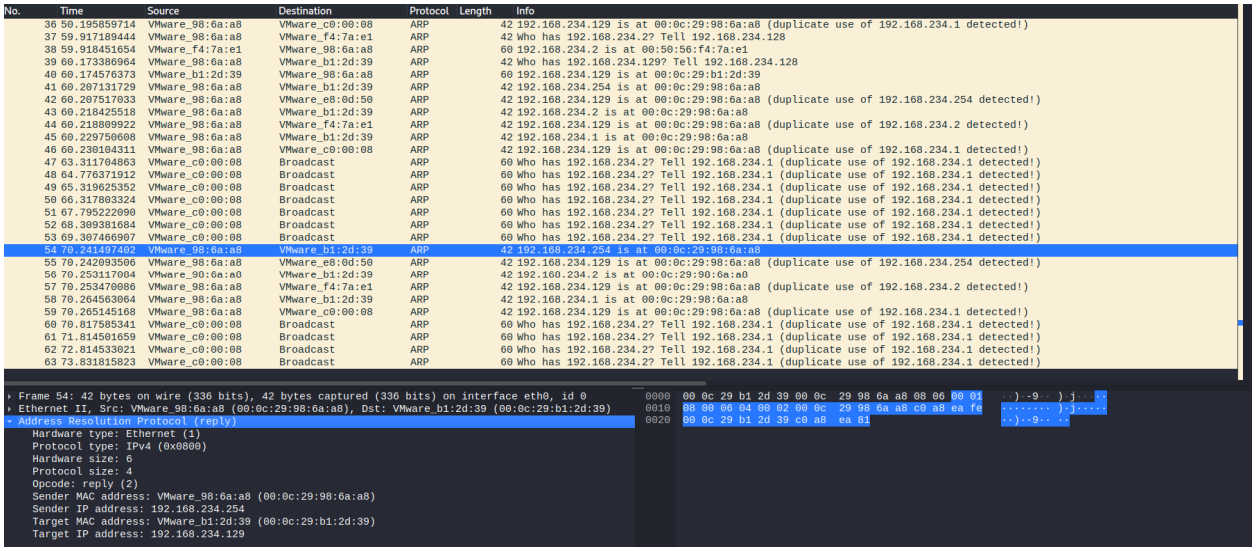
o. Execute "curl http://cs338.jeffondich.com/" on Metasploitable. On Kali, stop capturing. Do you see an HTTP response on Metasploitable? Do you see captured packets in Wireshark? Can you tell from Kali what messages went back and forth between Metasploitable and cs338.jeffondich.com?

i. I can now see packets sent between Metasploitable and cs338.jeffondich.com. I can see that Metasploitable sent an HTTP request to cs338.jeffondich.com and then cs338.jeffondich.com sent an HTTP response back to Metasploitable. I can see everything within the HTTP response (screenshot below).



p. Explain in detail what happened. How did Kali change Metasploitable's ARP cache? (If you want to watch the attack in action, try stopping the AITM attack by selecting "Stop mitm attack(s)" from Ettercap's Mitm menu, starting a Wireshark capture for "arp", and restarting the ARP poisoning attack in Ettercap.)

i. Kali sent ARP packets to the 4 different MAC addresses on Metasploitable, telling them that the IP addresses 192.168.234.1, 192.168.234.2, 192.168.234.254, and 192.168.234.128 have Kali's MAC address (00:0c:29:98:6a:a8). This can be seen in the screenshot below. Metaspoitable then changes its MAC addresses to Kali's MAC address within its ARP cache after receiving Kali's ARP packets.



q. If you wanted to design an ARP spoofing detector, what would you have your detector do? (As you think about this, consider under what circumstances your detector might generate false positives.)
    i. The detector would monitor the ARP cache to detect if more than one IP address is mapped to the same MAC address, which if true, would be a good indicator of ARP spoofing. This method could return false positives with an outdated network configuration so that there may be old devices and old IPs/MAC addresses in the cache. The detector could also look for very repetitive ARP responses from a particular source.

Synthesis:

a. First, Mal must be on the same network as Alice. Mal then scans the network to find IP addresses within the network. Mal starts sending ARP packets across the network that advertise that the correct MAC address for the IP addresses is Mal's MAC address. Alice receives these ARP packets and updates her ARP cache, which essentially connects all of her stored IP addresses for gateways, routers, and everything else to Mal's MAC address. As a result, when Alice wants to send a packet to Bob, she tries to first get the packet to the gateway, which just so happens to now be associated with Mal's MAC address and would therefore be sent to Mal. Mal would then be able to read, edit, or do whatever she wants with this intercepted message before passing it along to the gateway (if she wants).
b. If Alice is monitoring her ARP cache or ARP packets, this attack is very detectable. Alice could have some ARP cache poisoning protection program installed that is set up to notice if Alice is receiving a lot of repetitive ARP packets from a particular source or if Alice's ARP cache has multiple IP addresses mapped to the same MAC address.
c. No, the attack is not detectable from Bob's perspective. Even if Bob expects some form of authentication from Alice, it wouldn't matter to Bob if Alice sends those credentials or if Mal passes on those credentials to Bob after intercepting them from Alice.
d. Yes, it is likely that Alice and Bob could prevent this attack with HTTPS because when Alice requests a certificate from the server, Mal would have to somehow send back a valid certificate. If the certificate is invalid, the main thing Mal could do is use SSLStrip, which will still provide Alice with one notification that the certificate is invalid. However, if Alice chooses to ignore that notification, then Mal could successfully pull off the attack.