# Computer Security Capstone

## Project II: MITM and Pharming Attacks in Wi-Fi Networks

Chi-Yu Li (2023 Spring)
Computer Science Department
National Yang Ming Chiao Tung University

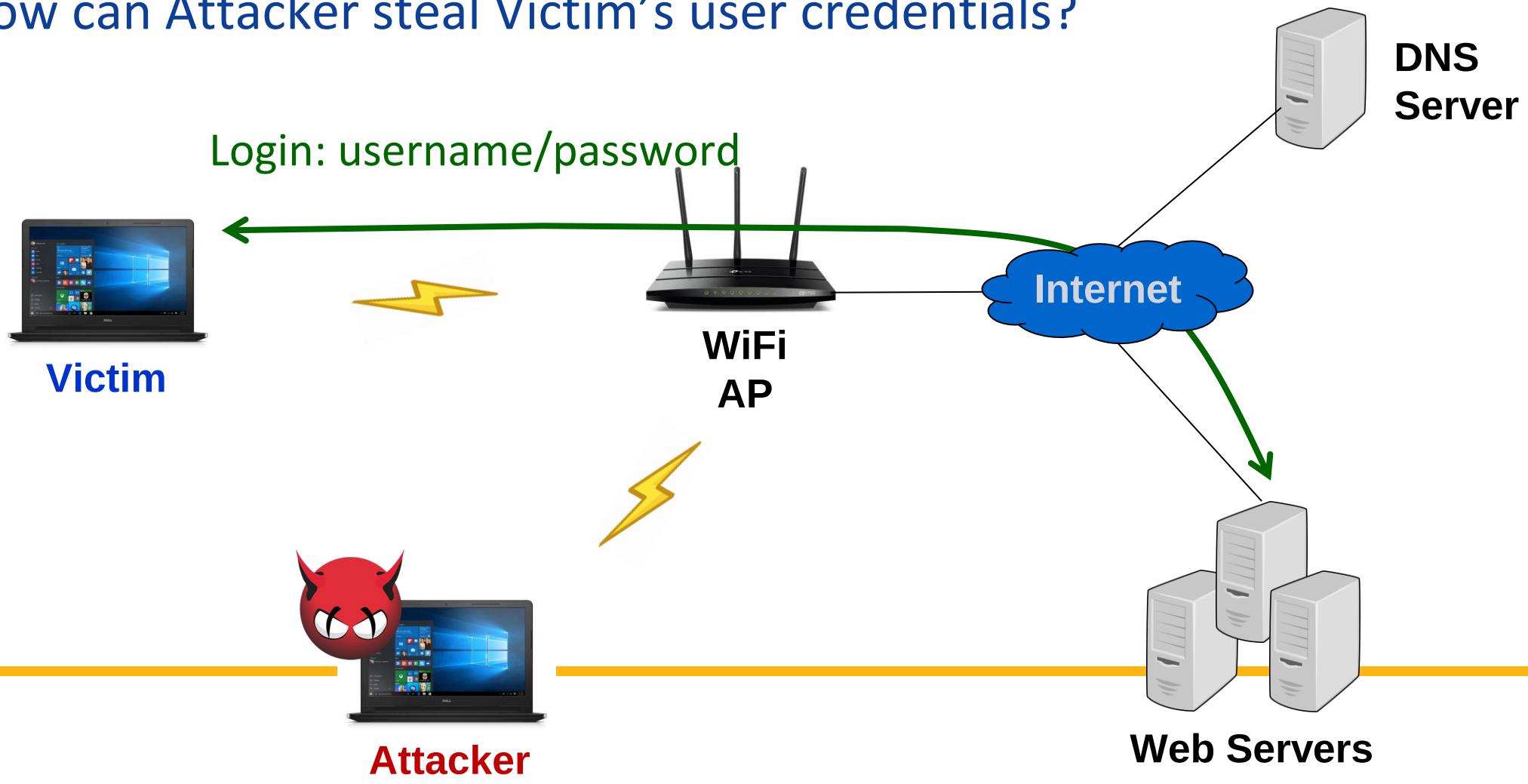
# Goal

- Understand how user credentials can be leaked by a man-in-the-middle (MITM) attack over Wi-Fi networks

- You will learn how to
  - scan IP/MAC addresses of the devices in a Wi-Fi network
  - launch an ARP spoofing attack
  - launch a man-in-the-middle attack
  - launch a pharming attack

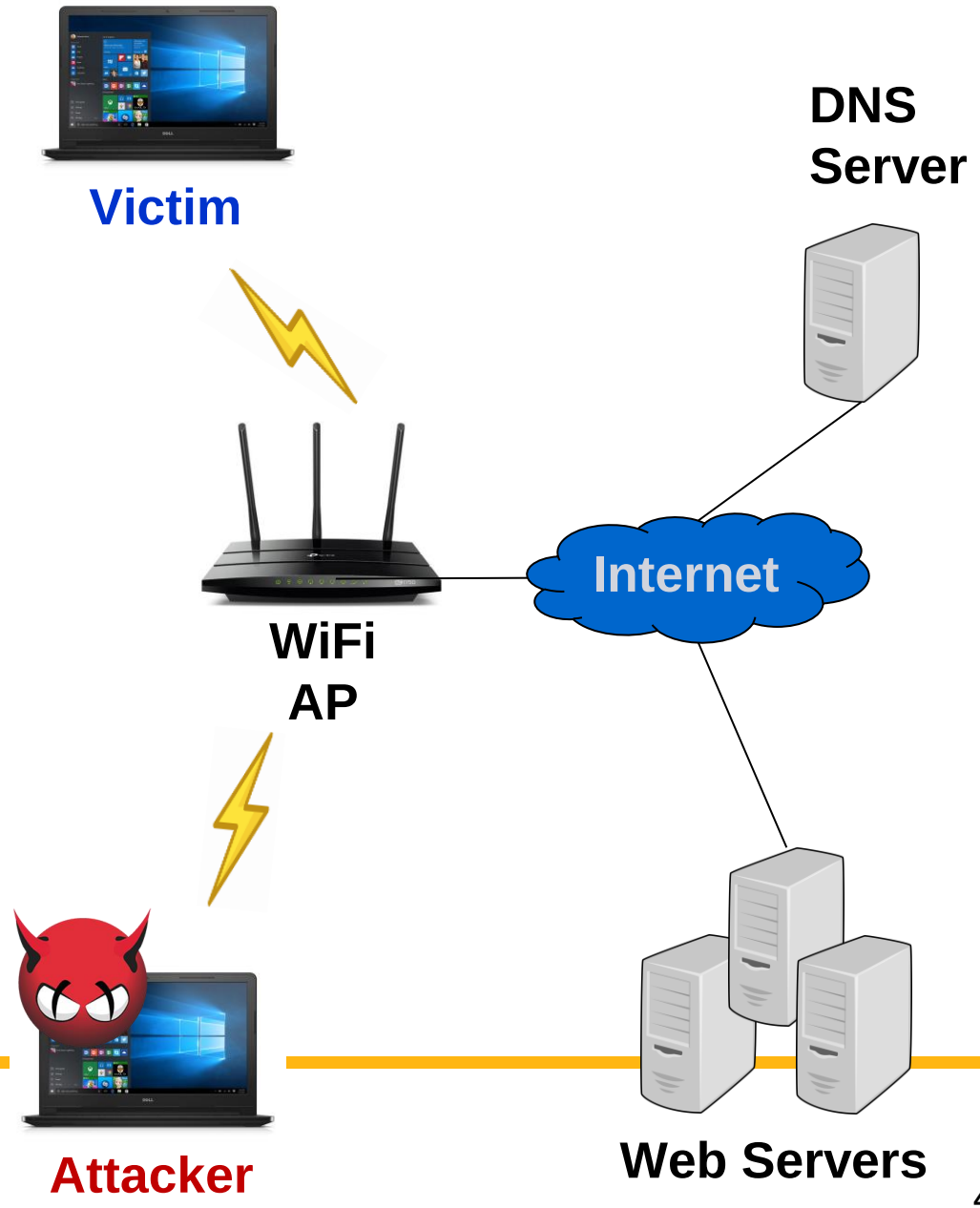
# Attack Scenario

- How can Attacker steal Victim's user credentials?



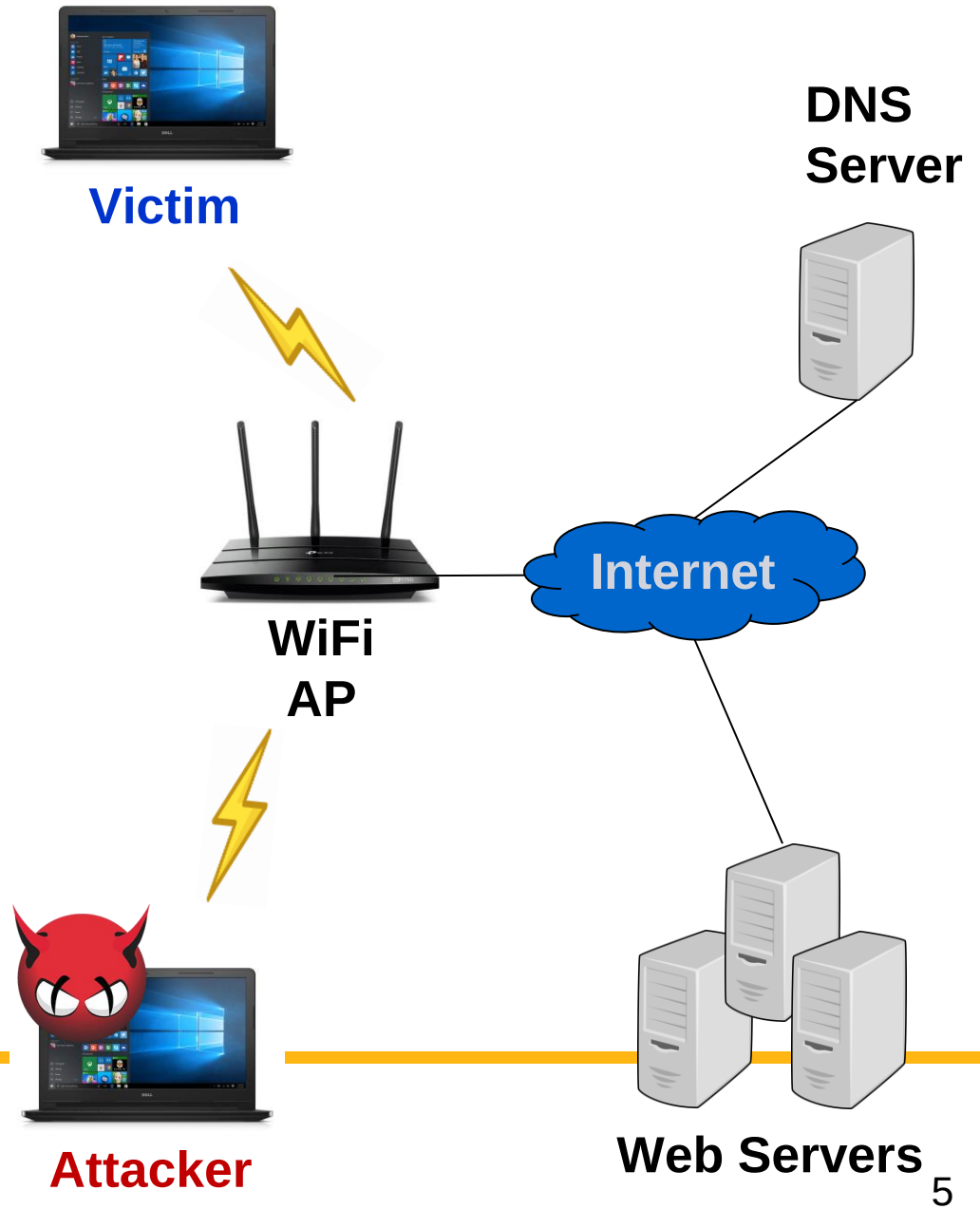
# Major Ideas

- Redirect Victim's traffic to Attacker
  - Man-in-the-middle based on ARP spoofing
  - How to know Victim's IP/MAC address?
- How about encrypted sessions?
  - MITM attack: split the encrypted sessions
  - Pharming attack: redirect HTTP requests to a phishing web page



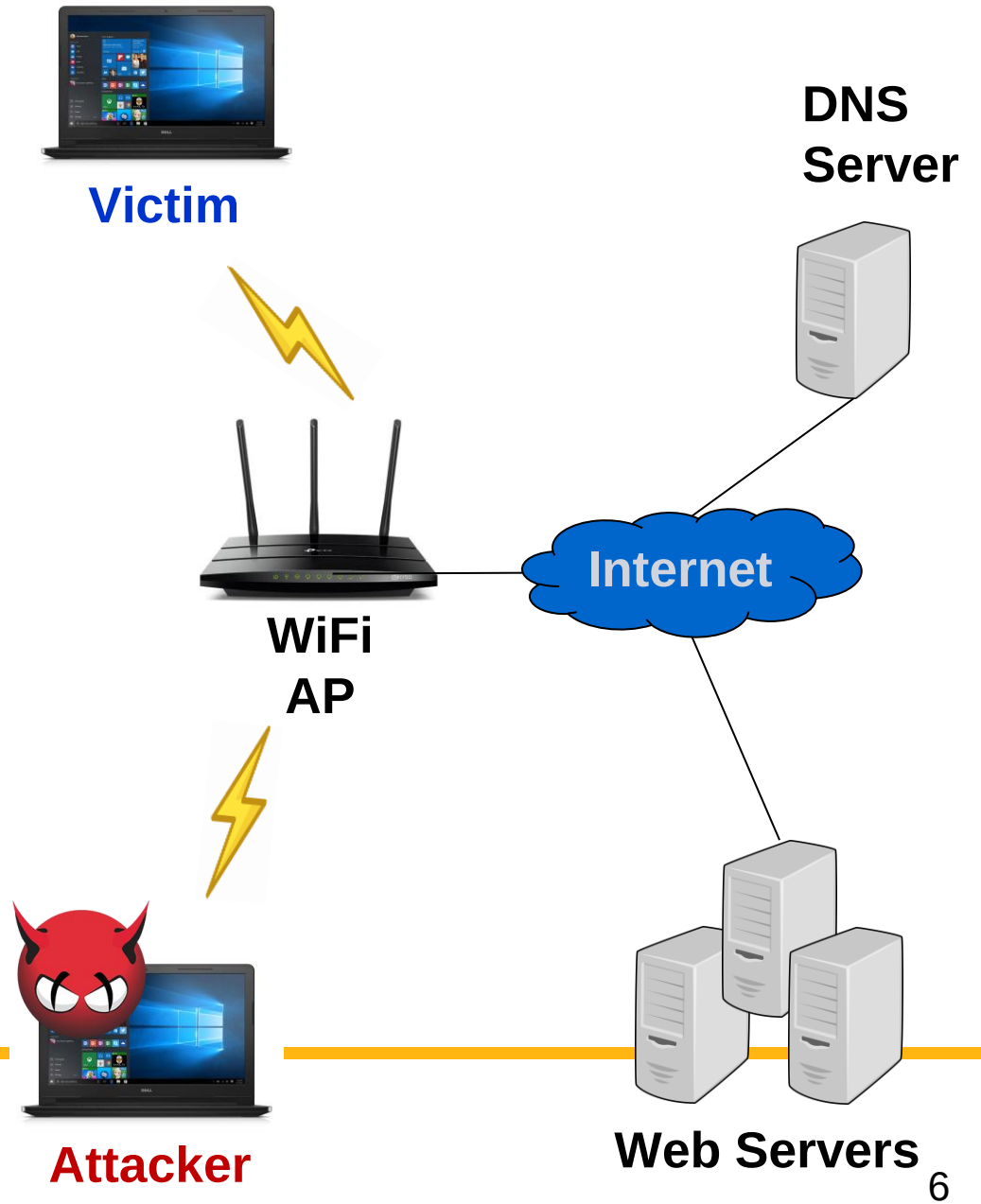
# Tasks: MITM and Pharming

- MITM Attack (60%)
  - Obtain all other client devices' IP/MAC addresses in a connected Wi-Fi network (Task I: 20%)
  - ARP spoofing for all other client devices in the Wi-Fi network (Task II: 15%)
  - Split SSL/TLS encrypted sessions and get the inputted username/password strings from HTTPS sessions (Task III: 15%)
  - One implementation question during the demo (10%)



# Tasks: MITM and Pharming

- Pharming Attack (40%)
  - Obtain all other client devices' IP/MAC addresses in a connected Wi-Fi network
  - DNS spoofing attack for web services (Task IV: 30%)
  - One implementation question during the demo (10%)



# Task I: Device Address Information Collection

- Scan all the devices' IP/MAC addresses in the Wi-Fi network
  - You can use 'scapy' and 'netifaces' library in Python or commands 'nmap', 'arp', and 'route'

```
cs2021@ubuntu:~/Desktop/project2$ sudo ./mitm_attack
Available devices
-------------------------------------
IP                  MAC
-------------------------------------
172.16.186.1        00:50:56:c0:00:08
172.16.186.141      00:0c:29:f2:d2:ab
172.16.186.254      00:50:56:ed:bd:5e
```

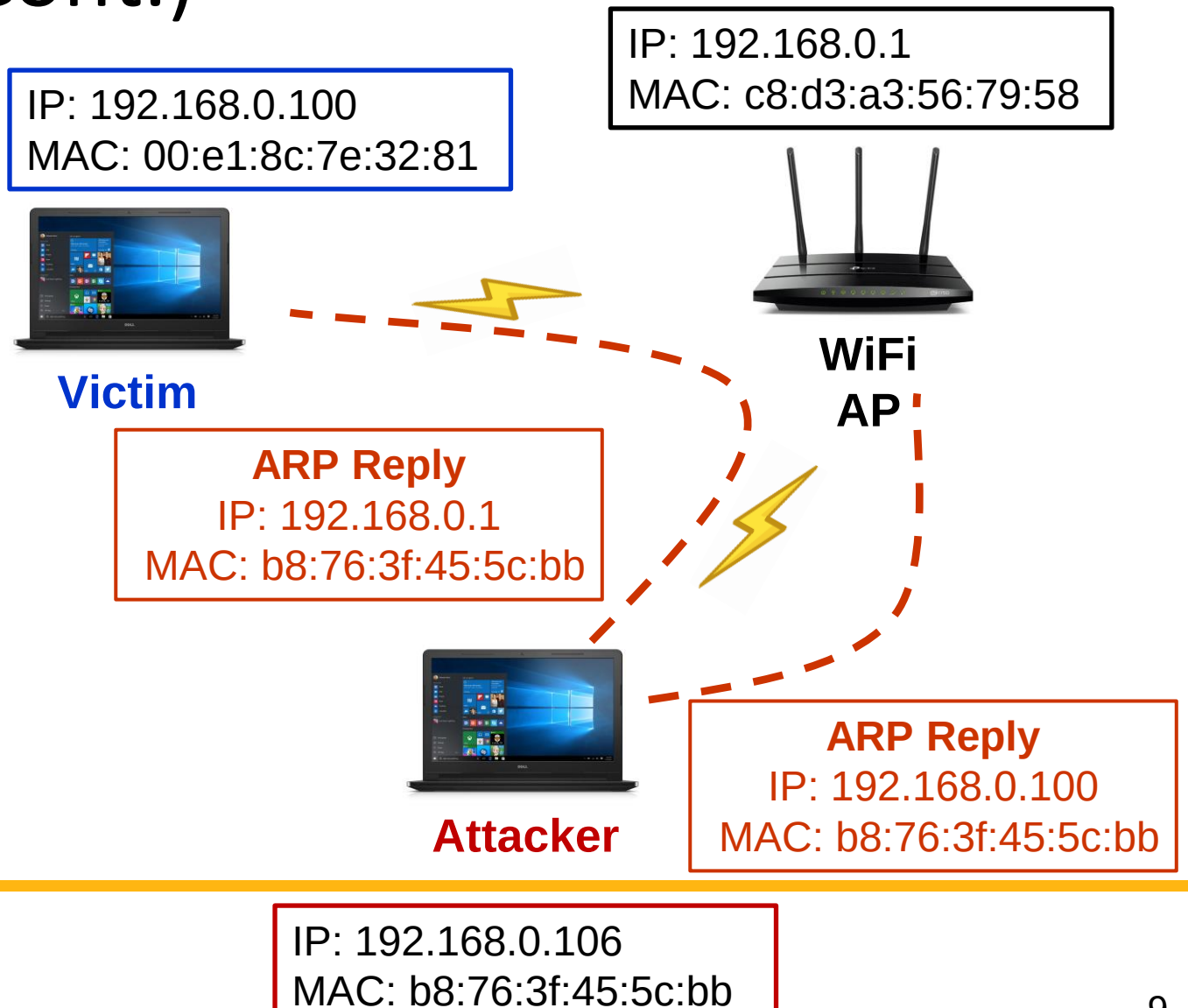
- Fetch the IP/MAC addresses of all the other client devices

# Task II: ARP Spoofing

- What is ARP (Address Translation Protocol)?
  - A communication protocol: discovering the link layer (or MAC) address associated with a given IP
  - A request-response protocol: messages are encapsulated by a link-layer protocol
    - ARP request: broadcast
    - ARP response: unicast
  - Never routed across internetworking nodes

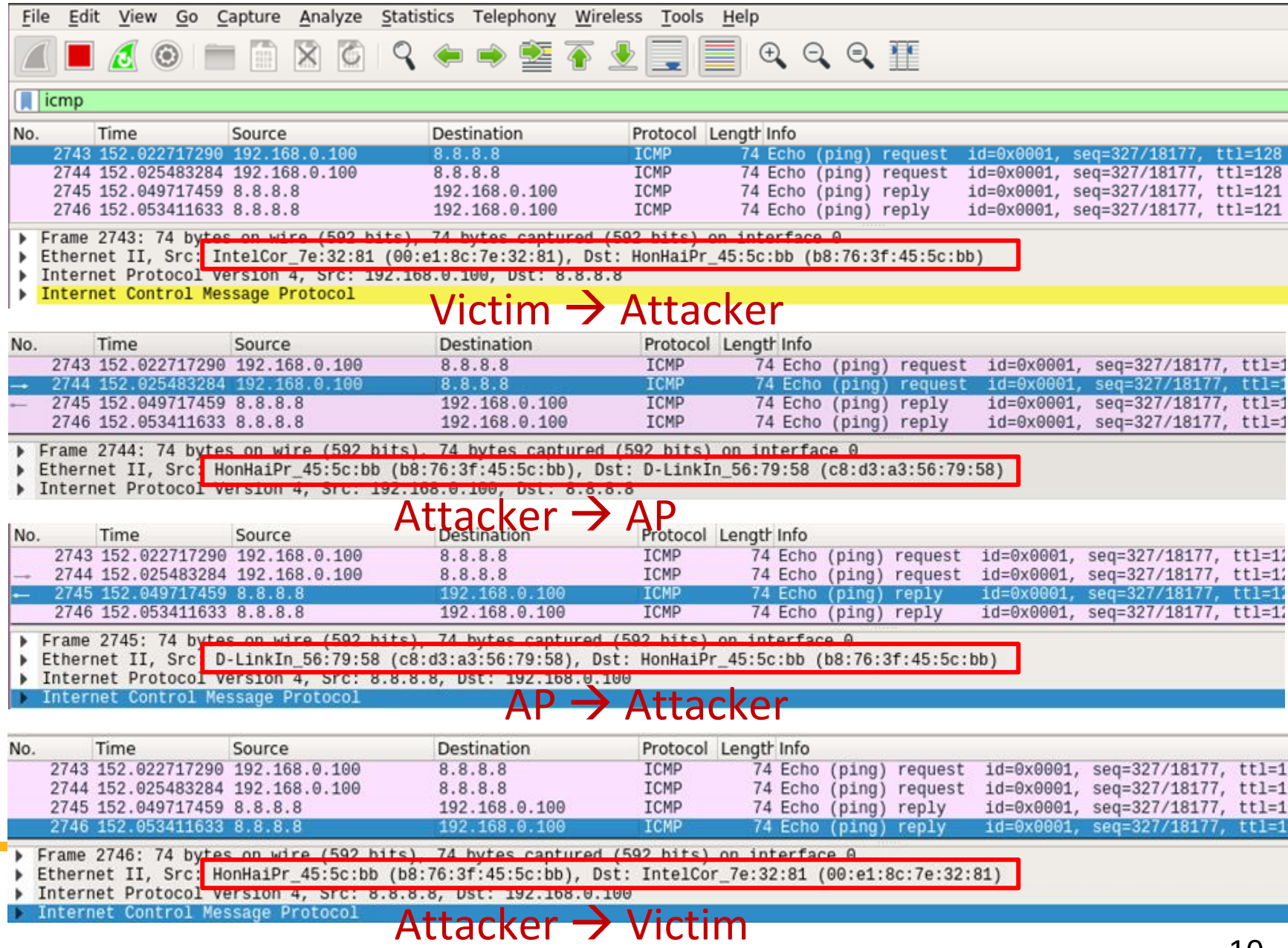
# Task II: ARP Spoofing (Cont.)

- Generate spoofed ARP replies for all other client devices
  - You can use ‘scapy’ library in Python
- Both uplink and downlink should be considered
  - Other client devices’ network services can work normally



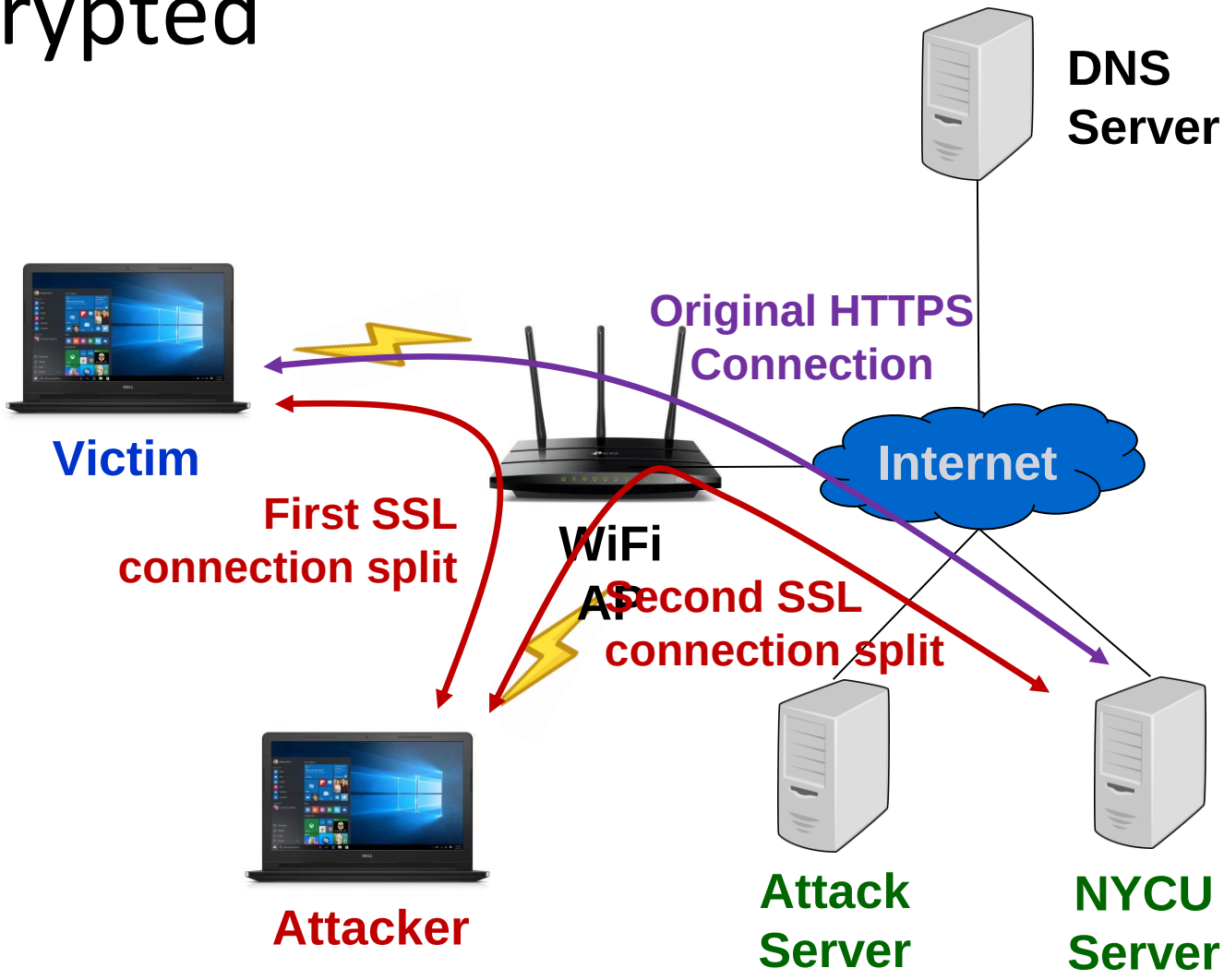
# Task II: ARP Spoofing (Cont.)

- An example trace of the successful ARP spoofing at Attacker



# Task III: SSL Split on Encrypted SSL/TLS Connections

- Split SSL/TLS connections
  - You can use ‘sslsplit’ command as a tool for this attack against encrypted network connection
  - You are allowed to install certificates on the victim

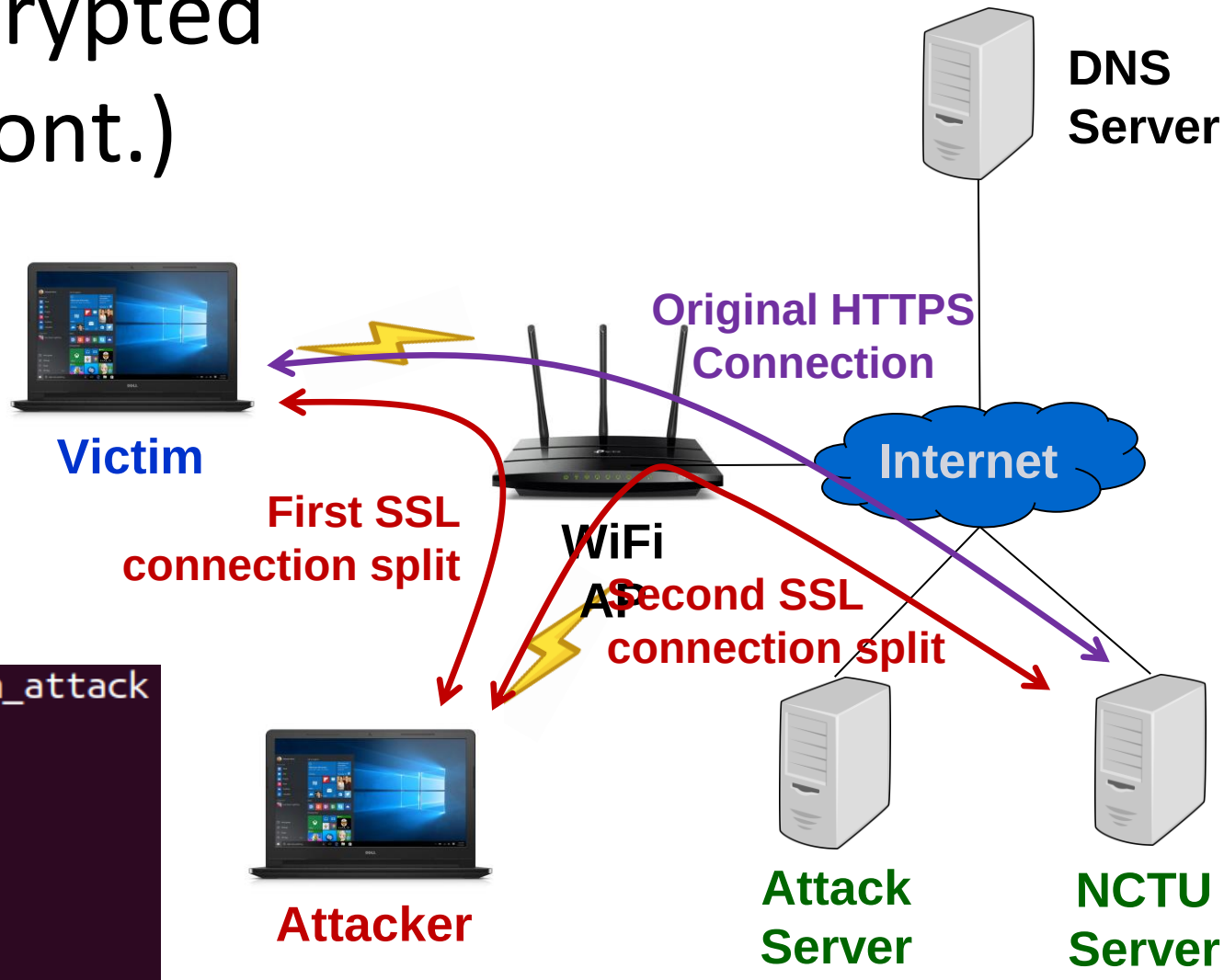


# Task III: SSL Split on Encrypted SSL/TLS Connections (Cont.)

- Fetch all the inputted usernames/passwords on a specific web page
  - Parse HTTP content to print out usernames/passwords

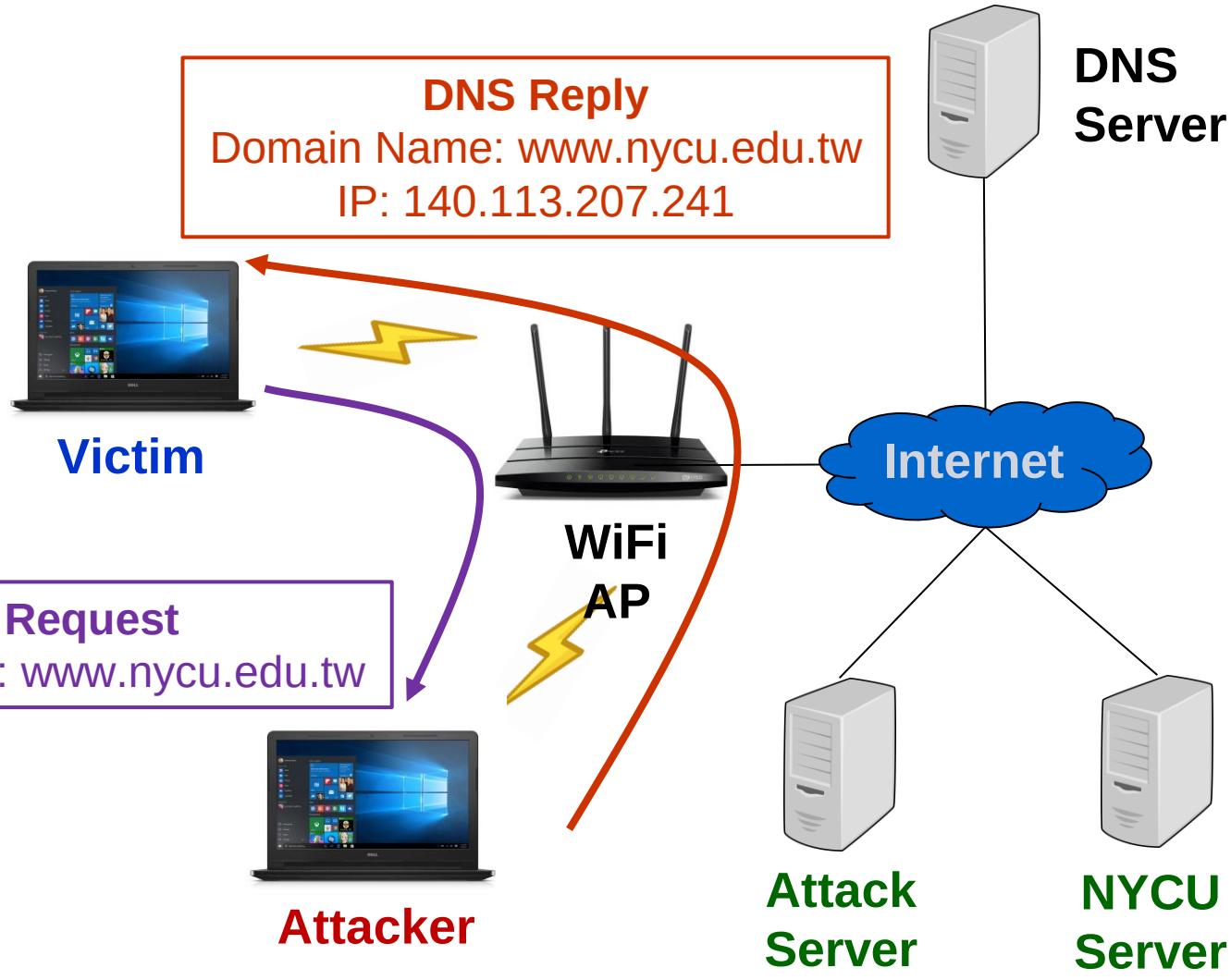
```
cs2021@ubuntu:~/Desktop/project2$ sudo ./mitm_attack
Available devices
-------------------------------------
IP                  MAC
-------------------------------------
172.16.186.1        00:50:56:c0:00:08
172.16.186.141      00:0c:29:f2:d2:ab
172.16.186.254      00:50:56:ed:bd:5e

Username:  this_is_demo_username
Password:  this_is_demo_password
```



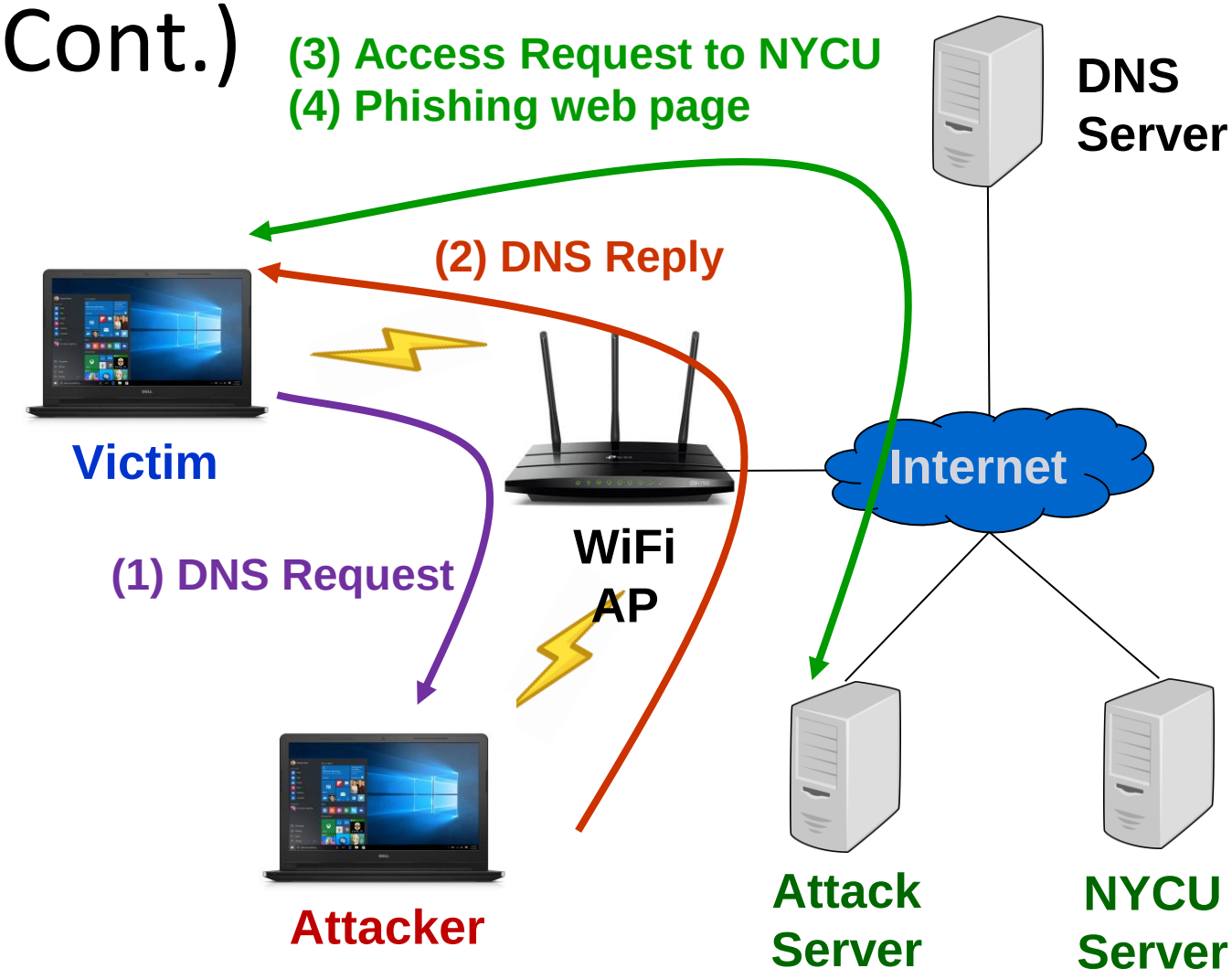
# Task IV: DNS Spoofing

- Intercept DNS requests for a specific web page and generate spoofed DNS replies with the attack server's IP
  - You can use 'scapy' and 'NetfilterQueue' library in Python



# Task IV: DNS Spoofing (Cont.)

- Successful attack
  - An access request to NYCU home page will be redirected to the attack server (140.113.207.241)
  - A phishing web page will be shown to Victim

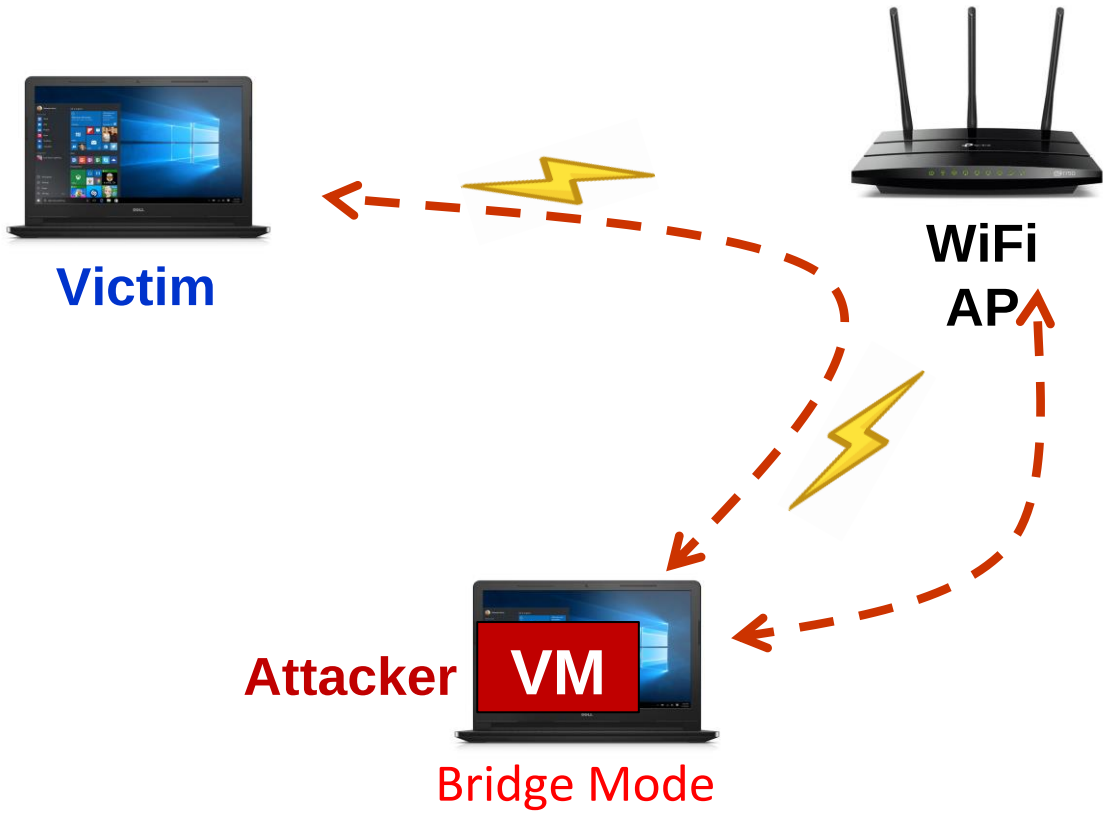


# Requirements

- You need to develop/run your program in a given virtual machine
  - VM image: Please download it from Link
    - Username/password: csc2023/csc2023
- You are allowed to use C/C++ and Python
- You are allowed to team up. Each team has at most 2 students
  - Teams: discussions are allowed, but no collaboration
- Please submit your source codes to New E3

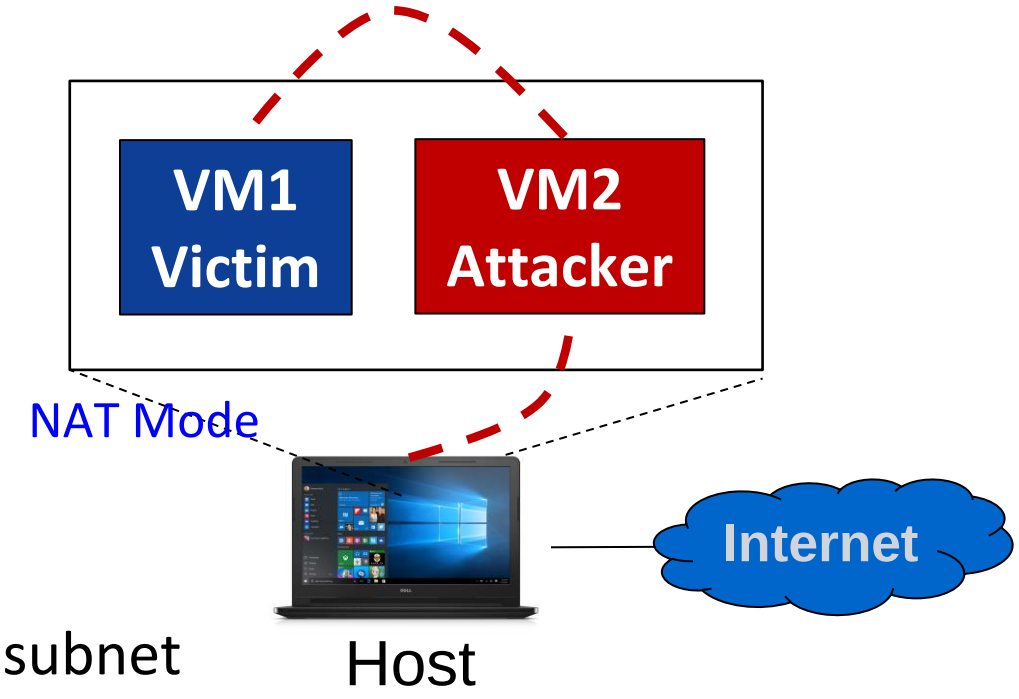
# Test Scenario I: Target Scenario

- However, this scenario does not work for all the combinations of OS and VM software
  - Working: Linux + VirtualBox/VMware
  - Not working properly
    - Windows + VirtualBox/Vmware
    - MacOS + VirtualBox
- You can choose Test Scenario II



# Test Scenario II: Alternative Scenario

- VM2 (Attacker) launches attacks on VM1 (Victim)
  - NAT mode shall be used for VMs
- Host is similar to the role of the AP in Test Scenario I
  - Scenario I: The Wi-Fi devices are in the same subnet
  - Scenario II: The VMs are in the same subnet
- Host can be connected to the Internet via Wi-Fi or wired Ethernet



# Important: How to Prepare Your Attack Programs?

- Must provide a **Makefile** which compiles your source codes into two executable files, named **mitm_attack** and **pharm_attack** (Missing: -20%)
- Test requirements for the programs
  - Must be run in the given VM without any additional tools or libraries
  - Must use the following parameters
    - Test web page in the man-in-the-middle attack: https://e3.nycu.edu.tw/login/index.php
    - DNS spoofing for the NYCU home page: http://www.nycu.edu.tw
    - Attacker server IP in the DNS spoofing: 140.113.207.241
  - Must work for the test commands: ./mitm_attack and ./pharm_attack

# Important: How to Prepare Your Attack Programs?

- Results from the MITM attack (./mitm_attack)
  - Print out the IP/MAC addresses of all the Wi-Fi devices or VMs except for Attacker and AP/Host
  - Print out the username and password which a user submits to the website https://e3.nycu.edu.tw/login/index.php using any of the Wi-Fi devices or VMs
- Results from the pharming attack (./pharm_attack)
  - Print out the IP/MAC addresses of all the Wi-Fi devices or VMs except for Attacker and AP/Host
  - Redirect the NYCU home page (www.nycu.edu.tw) to the phishing page (140.113.207.241)
- Demo
  - Verify the MITM attack by giving inputs on the website using one Wi-Fi device or VM
    - Only allowed to run ./mitm_attack (No manual configuration is allowed)
  - Verify the pharming attack by accessing the NYCU page on one Wi-Fi device or VM
    - Only allowed to run ./pharm_attack (No manual configuration is allowed)

# Project Submission

- Due date: 4/12 11:55pm
- Makeup submission (75 points at most): TBA (After the final)
- Submission rules
  - Put all your files into a directory and name it using your student ID(s)
    - If your team has two members, please concatenate your IDs separated by “-”
  - Zip the directory and upload the zip file to New E3
  - A sample of the zip file: 01212112-02121221.zip
    - Makefile
    - mitm_attack.cpp
    - mitm_attack.h
    - ….

# Online Project Demo

- Date: 4/14
- Makeup submission (75 points at most): TBA (After the final)
- TA will prepare your zip file and run your programs for the demo on behalf of you
- You will
  - be asked to reproduce your MITM and pharming attacks
  - be only allowed to “make” to compile all your files, and run your attack binary programs or scripts
  - be not allowed to modify your codes or scripts
  - be asked some questions
  - be responsible to show and explain the outcome to TA

# Questions?