# Homework #1

Due Time: 2016/3/9 (Wed.) 17:00
Contact TAs: `vegetable@csie.ntu.edu.tw`

## Submission

- Compress all your files into a file named **HW1_[studentID]_[version].tar.gz**, which contains two folders named **[studentID]_NA** and **[studentID]_SA** respectively.

- **Folder [studentID]_NA** should contain a pdf file of all your answers in *Network Administration Part*, and a file named *[studentID].pcapng*.

- **Folder [studentID]_SA** should contain all files in *System Administration Part*.

- Submit your tar file to **sftp://140.112.30.58:7000** with your workstation account and password.

## Instructions and Announcements

- Discussions with others are encouraged. However, you should write down your solutions `in your own words`. In addition, for each problem you have to specify the references (the Internet URL you consulted with or the people you discussed with) on the first page of your solution to that problem.

- Problems below would be related to the material taught in the class and might be far beyond that. Try to search for additional information on the Internet and give a reasonable answer.

- Some problem below might not have standard solutions. We would give you the point if your answer is followed by reasonable explanations.

- **NO LATE SUBMISSION IS ALLOWED.**

# Network Administration

## 1 Internet model

### 1.1 (10%)

Internet is so important in modern society that many restaurants, shopping malls and hotels are providing free Wi-Fi for their customers. While we are trying to connect to Wi-Fi networks, we usually ask for password but not the IP address configurations. Thats because a protocol called DHCP(Dynamic Host Configuration Protocol) does all the confgiurations for us. Try to find out which layers DHCP and IP belong to respectivly using the 5-layer model mentioned in class. Please write down the English name of the layers they belong to.

### 1.2 (20%)

After we connected to Wi-Fi network successfully, we may start to surf the Internet. For example, type www.youtube.com in the URL bar and then we can start search for videos we would like to watch. Please name two application protocols that may be used after the URL is entered and describe what they did.

### 1.3 (bonus 20%)

If we are watching youtube using Chome browser, then we may be using the experimental QUIC protocol instead of TCP. QUIC is developed by google and it supports secure, low latency connections over UDP. Try to find out which layers QUIC belongs to using OSI 7-layer model. Please write down the English name of the layers and your explanation.

## 2 IP

### 2.1 (10%)

Weve mentioned using DHCP to configure IP address settings in Part 1. Usually, IP addresses assigned using DHCP are private IPs. How can you tell if an IP is public or private?

### 2.2 (20%)

One of the reasons we use private IPs is because of IPv4 address exhaustion. This problem also caused the development and deployment of IPv6. Besides having larger address space than IPv4, please write down two other differences between IPv6 and IPv4.

### 2.3 (20%)

Can you connect to IPv6 sites with your browser? Please name three softwares/devices that may need new settings to make IPv6 work.

# 3    Wireshark (20%)

Wireshark is a software that can capture and analyze network traffic. Please use Wireshark to record all the packets transmitted while connecting to www.ntu.edu.tw(140.112.8.116).  Then utilize the built-in filter to get the pakcets that has source IP 140.112.8.116 and the protocol being HTTP. You may see the contents of the web page inside the packets.  Write down the conditions you designed for filtering, and export specified packets as a file named ¡student ID¿.pcapng", which must also be uploaded as a part of your homework.

# System Administration

## 1  Shell Scripts

A big advantage of using commands is that it is easy to combine several simple commands to do a more complex task. Writing shell scripts is the most common and easy way to make use of command line tools to automate routine tasks, manipulate files or process output.

Please write a shell script for each following problem and send all scripts in a tarball. All scripts should have their execute permission set, so it can be used as a regular executable.

You are allowed to use the standard (POSIX) shell or GNU Bash.

- If you use the standard shell, the first line of your script must be `#!/bin/sh.` You can use dash on GNU/Linux or sh on *BSD to test your script. You are encouraged to write scripts using the standard shell, but you must not use any bash-specific features in a `#!/bin/sh` script. You can use checkbashisms command to check whether the syntax is allowed by the standard.

- If you use GNU Bash, the first line of your script must be `#!/usr/bin/env bash`. Please dont use `#!/bin/bash` because hard-coding the path of bash is known to cause problems on many platforms, including most *BSD systems.

### 1.1  Total memory usage of a whole grade (30%)

Before the deadline of the system programming homework, you noticed that there are many classmates running programs on CSIE workstation. Curious, you want to know how much memory has used by all *b04XXXXXX* (or *b03XXXXXX*, etc) accounts. You decided to write a script allows you to calculate it fast.

When an user run

```
./total_mem_usage.sh b04
```

Your script should print a number representing the total memory usage of all b04xxxxxx acounts in kbytes.

**Hint**    You can use the command "`ps aux`" to see every running processes, where USER representing the owner of the process, VSZ representing the memory usage in kbytes.

### 1.2  List total memory usages of grades (40%)

Following the previous problem, now you want to now you want to list memory usages of all grades in decreasing order rather than just print the one of a specific grade. (The first three letters of a user in a specific grade is "ABC", where A is a lower-case alphabet and B, C are digits.)

For example, when an user run

```
./total_mem_usage_list.sh
```

And if the output of "`ps aux`" is

```
USER       PID %CPU %MEM    VSZ    RSS TTY      STAT START   TIME COMMAND
```

```
b029020+ 29005  0.0  0.0  12345   3352 pts/11   R+   14:46   0:00 ps aux
b029020+ 29005  0.0  0.0  38020   3352 pts/11   R+   14:46   0:00 vim
b049020+ 29146  0.0  0.1 539104 100600 pts/12   T    08:13   0:15 vim b02.txt
r029220+ 29146  0.0  0.1  56789 100600 pts/12   T    08:13   0:15 tmux
www         36  0.0  0.0      0      0 ?         S     216   0:03 apache
r029220+ 29146  0.0  0.1  12345 100600 pts/12   T    08:13   0:15 tmux
root        36  0.0  0.0      0      0 ?         S     216   0:03 sshd
```

Your script should print

```
b04 539104
r02 69134
b02 50365
```

**Hint**  You can call the script *total_mem_usage.sh* you have implemented. You can assume that *total_mem_usage_list.sh* and *total_mem_usage.sh* are in the same directory.

## 2  Shared Folders and Files (30%)

It is common to have a shared folder or shared git repository when working on a project with several people in a team. ACL can manage complex settings that the standard Unix permission is not be able to. You can use getfacl and setfacl to view and manage ACL settings.

Please create a shared folder with its permission set to satisfy the following requirements:

1. There are 3 team members: **student1**, **student2** and **student3**. All of them are members of student group. They can add, modify or delete any file and folder in this shared folder, regardless the owner of the file or folder.

2. There are 2 TAs: **ta1** and **ta2**. They are allowed to read all files and folders in this shared folder, but addtion, modification and deletion is not allowed.

3. There is a group: **prof**, having the same permission as TAs.

4. All other people, including users in student group that are not a team member, are not permitted to access any file in this shared folder.

The following message is a sample output of getfacl command running on the shared folder with several parts was replaced by underscores. Please fill in all underscores with correct settings.

```
1 # file: project_shared_folder
2 # owner: student1
3 # group: student
4 user::rwx
5 user:student1:___
6 user:student2:___
7 user:student3:___
8 user:ta1:___
9 user:ta2:___
10 ___:prof:___
11 group::___
12 mask::___
13 other::___
```

**Note**   Although ACL is an abandoned POSIX standard, it is already implemented on many Unixlike systems, including Linux and FreeBSD. If you get Operation not supported error when using setfacl command, please try these possible solutions before asking.

1. Ext2, Ext3, Ext4 filesystem on Linux: `mount -o acl`, `remount /path/to/mount/point`

2. tmpfs on Linux should work without problems.

3. UFS on FreeBSD: `mount -o acls`, `update /path/to/mount/point`

4. tmpfs on FreeBSD does not support ACL. If you really want to use a ramdisk, please use `mdconfig -a -t malloc -s size` to create a memory disk device and format and mount it like a regular UFS filesystem.