國立成功大學 110 學年度 第二學期

計算機系統與網路管理

期中考題

National Cheng Kung University, 111 A
Computer System & Network Administration
Midterm

- Date/Time: 111/04/21 (Thu.) 14:00 ~ 16:00 (2hr)
- Close Book, **No Electric Equipment is allowed**
- Operating System: Ubuntu Linux, 20.04 Server
Default Shell: /bin/bash
- The questions will be in both English and Chinese
Both English and Chinese answers are acceptable
- Total: 120 points

========================= Questions start from here =========================

Part A. 單選題 [一題 4 分，共 40 分]

Part A. Multiple Choice [4pt for each question, 40pt total]

1. 請問以下關於 `sudo` 及 `su` 指令的描述何者為真?

   Which statement is true about command `sudo` and `su`?

   A. `sudo su` 可以切換成名為 `su` 的帳號
   We can use `sudo su` to switch to account `su`.

   B. `sudo root` 可以切換成 `root` 的帳號
   We can use `sudo root` to switch to account `root`.

   C. `sudo su -` 可以切換成 `root` 的帳號
   We can use `sudo root -` to switch to account `root`.

   D. 執行 `sudo su` 需要輸入 `root` 帳號的密碼
   Password of the `root` is asked when using `sudo su`.

2. 請問以下何者為 `/etc/shadow` 裡存放的資訊？

   Which information is stored inside `/etc/shadow` ?

   A. 使用者密碼的 Hash
   Hash of the users' password

   B. 影子分身帳號
   Shadow user

   C. 使用者 id
   User id

   D. 群組 (group) id
   Group id

3. 當使用者 bob 登入時，何者是系統最先載入的環境設定腳本？

   Which script is loaded first when user bob is logging in?
   - A. /home/bob/.profile
   - B. /home/bob/.bashrc
   - C. /etc/profile
   - D. /home/bob/.bash_profile

4. 下列關於 dockerfile 中的 EXPOSE 的描述何者正確？

   Which statement is true about EXPOSE in dockerfile ?
   - A. 將 build 出來的 image 能夠成功被暴露出來供使用者存取

     It exposes the image so that users can access it after it is built.
   - B. 讓開發者知道該 image 需要對外暴露哪個 port

     It tells developers which port/ports need to be exposed.
   - C. 主動將 port 對外暴露

     It exposes the specified ports of the container.
   - D. 將 container 的 stdout 導向至指定檔案

     It redirects the stdout of the container to a specific file.

5. symbolic link 與 hard link 的性質何者正確？

   Which statement is true about symbolic link and hard link.
   - A. hard link 指向檔案的 file descriptor

     Hard link points to the file descriptor of a file.
   - B. hard link 不能跨分割區

     Hard link cannot be created across two partitions.
   - C. symbolic link 指向檔案的 inode

     Symbolic link points to the inode of a file.
   - D. 刪除 hard link 指向的檔案會造成該 hard link 無法正常使用

     Deleting the file pointed by a hard link may cause this hard link to be inaccessible.

6. 請問下列關於 apt 命令以及 dpkg 命令得描述何者正確？

   Which statement is true about command apt and dpkg
   - A. dpkg 會解決安裝模組的相依性問題

     dpkg deals with the dependencies of installed packages.
   - B. dpkg 的底層為 apt

     dpkg is based on apt.
   - C. dpkg 只能進行本地安裝

     dpkg can only perform local installation.
   - D. dpkg 能安裝 .rpm 格式的檔案

     dpkg can install .rpm files.

7. 下列關於 `apt` 的描述，何者正確？

   Which statement is true about `apt`?

   A. `apt update` 會更新既有的套件

      `apt update` updates existing packages.

   B. 使用 `apt upgrade` 時需要下載套件的原始碼檔案

      `apt upgrade` downloads the source code of the packages.

   C. `apt update` 會獲取最新的套件資訊

      `apt update` fetches the latest information of packages.

   D. mirror site 的作用為紀錄使用者安裝的套件清單

      Mirror site stores the list of installed packages of each user.

8. 關於該指令 `ps aux | less` 的描述何者正確？

   Which statement is true about command `ps aux | less`?

   A. 這行指令等效於 `ps aux && less`

      It is equivalent to `ps aux && less`.

   B. `|` 可以將兩個指令的輸出做 or 操作

      `|` performs bitwise OR operation between two outputs of the commands.

   C. `|` 會將 less 的 stdout 傳遞到 `ps aux` 的 stdin

      `|` passes the content of stdout of less to stdin of `ps aux`.

   D. `|` 是可以讓兩個 process 互相通訊的 pipe

      `|` stands for pipe, which can be used for interprocess communication.

9. 請問下列哪個 signal 無法被 **catch** ？

   Which signal cannot be **caught**?

   A. `SIGHP`
   B. `SIGINT`
   C. `SIGTERM`
   D. `SIGSTOP`

10. 請問如果要禁止使用者 `mark` 登入，應該採取下列何種動作？

    What should we do to prohibit user `mark` from login?

    A. 刪除 `mark` 的家目錄 (home)

       Delete the home directory of `mark`.

    B. 修改 `/etc/passwd` 中 mark 的登入 shell 為 nologin

       In `/etc/passwd`, change the login shell of mark to nologin.

    C. 使用指令 `apt remove mark`

       Use the command `apt remove mark`.

    D. 使用指令 `nologin mark`

       Use the command `nologin mark`.

Part B. 簡答 [每題 5 分，共 40 分]

## Part B. Short Answer [5pt for each question, 40pt total]

1. 下圖為 RAID 0 的儲存架構圖，假設用三顆硬碟組成 RAID 5，請畫出(或寫出)系統是如何儲存 Data ($A_1 A_2 A_3 A_4 A_5 A_6$) 與 Parity bit ($P_1 P_2 P_3$) 在三顆硬碟中 (2pt)?

   The following figure shows the storage architecture of RAID 0. Suppose that we build RAID5 with 3 disks, please draw/write how the system stores Data ($A_1 A_2 A_3 A_4 A_5 A_6$) and Parity bit ($P_1 P_2 P_3$) in 3 drives (2pt) ?

   假設三顆硬碟為相同型號與容量，每顆容量為 50GB ，請問在組成 RAID 5 後，實際可儲存資料的容量為多少 GB (3pt)？

   Suppose these 3 disks are 50GB each, what is the capacity of the built RAID5 (3pt)? (answer in GB)
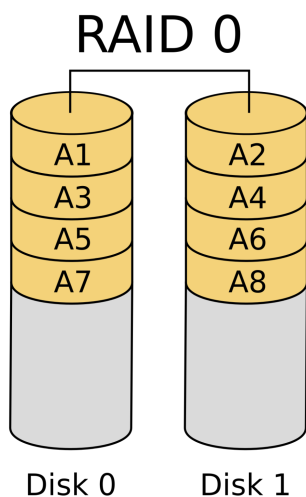
2. 寫出兩個 GPT 相比 MBR 的優勢 (一個 2.5pt)

   Write down two advantages of GPT compared to MBR (2.5pt each)

3. 已知檔名為 "myFile" 的檔案有以下內容 (檔案最後沒有換行)：

   This is the content of the file `myFile` (There is **no** '\n' at the end of the file):

   ```
   hello
   ```

   請問執行以下指令 `echo "nasa\nmidterm" >> myFile`，terminal 跟檔名為 "myFile" 的檔案分別會有什麼內容？(若沒有任何內容，請寫 (None))

   Please write down the output of the terminal and the content of `myFile` after executing `echo "nasa\nmidterm" >> myFile`.(If there is no content, just answer (None))

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4. Smith (使用者名稱 `smith`) 的電腦上創建了一個資料夾名為 `family_memory` (Smith 有所有權限)，他想與他的家人 `family` 這個 group 共用，並且不給自己及 `family` 以外的人任何權限，而家人只允許讀取跟進入這個資料夾，不允許變更資料夾的內容。他應該將 `family_memory` 資料夾的權限設為 (1)?

   此外，Smith 想將一個影片 `oscar.mp4`

   放到這個資料夾，並且設為**只有自己**有權限存取，包括讀取跟編輯，而由於是影片，不應該要能執行，他應該將影片的權限設為 (2)?

   回答格式請以 `<username> <group_name> <permission>` 來作答。e.g. `smith smith rwxr_xr_x`

   Smith (username `smith`) created a directory called `family_memory` on his computer. He has all the permission. He wants to share with his family (a group called `family`) and only allow them to read and enter this directory. They are not allowed to modify the content under `family_memory`. Access for anyone else is denied. He should set the permission of `family_memory` to (1)?

   In addition, Smith wants to add a video `oscar.mp4` to this directory and only allows himself to access it (including read and write permission). Because it is a video, it shouldn't be executed. Smith should set the permission of `oscar.mp4` to (2)?

   Please answer the questions in the format of `<username> <group_name> <permission>`. e.g. `smith smith rwxr_xr_x`.

5. 假設以下狀況 ($ 為 prompt)：

   Assume that ($ is the command prompt):

   ```
   $ ls
   $ cat nasa_midterm
   cat: nasa_midterm: No such file or directory
   ```

   請問若接著執行 `cat nasa_midterm > file 2>&1`，file 的內容會是？

   What is the content of the file after executing `cat nasa_midterm > file 2>&1`?

6. 請問以下兩種情境，應在 `/etc/sudoers` 添加什麼？

   a. 允許使用者 `smith` 不用密碼就能關機 (即執行 `sudo poweroff` 不須輸入密碼)，且可以在任意主機以任意使用者及群組執行，已知 `poweroff` 路徑在 `/usr/sbin/poweroff`

   b. 允許使用者 `john` 可以在任意主機以任意使用者及群組執行任意指令，但需要輸入密碼

   What should be added to `/etc/sudoers` to satisfy the following conditions?

   a. User `smith` is allowed to power off the machine without password (i.e. execute `sudo poweroff` without password) and can execute the command as any user and group

on any hosts. Note that the absolute path of `poweroff` is `/usr/sbin/poweroff`.
   b. User `john` is allowed to execute any command as any user and group on any hosts. Password is required in this case.

Hint: An example sudoers format `user host=(runas_user:group) command`

7. 根據以下條件，完成 systemd service 的 unit file：

   a. 執行程式：`/usr/local/bin/node app.js`

   b. CPU 用量低於 40%

   c. 記憶體最大用量小於 2G

   d. 環境變數 `NODE_ENV` 設為 `production`

   According to the following requirements, complete the systemd service unit file:
   a. Execute `/usr/local/bin/node app.js`
   b. CPU usage must be lower than 40%
   c. Maximum Memory usage must be lower than 2G
   e. Environment variable `NODE_ENV` set to `production`

```
[Unit]
Description=Node App

[(1)]
ExecStart=(2)
WorkingDirectory=/var/www/html
(3)=40%
(4)=2G
Environment=(5)

[Install]
WantedBy=multi-user.target
```

8. 考慮以下程式碼，請問執行這段程式碼會輸出幾個 `hello` 呢？請簡述其原因。

   Consider the following code. How many `hello` are printed if I execute the program? Please briefly explain it.

```c
#include <stdio.h>
#include <unistd.h>

int main() {
        printf("hello\n");
        fflush(stdout);
        fork();
        for (int i = 0; i < 10; ++i) {
                printf("hello\n");
        }
        fflush(stdout);
        fork();
        return 0;
}
```

```c
#include <stdio.h>
#include <unistd.h>

int main() {
        printf("hello\n");
        fflush(stdout);
```

Part C. 情境 [每題 20 分，共 40 分]

Part C. Situation[20pt for each question, 40pt total]

情境一 Backup script repair

```
root@vm:~# ls -l /backup/backup.sh
-rw-r--r-- 1 root root 0 Mar 31 14:43 /backup/backup.sh

root@vm:~# tail -n 1 /etc/crontab
0 0 * * 0,3 root bash /backup/backup.sh 2>> /var/log/backup_err.log | tee
-a /var/log/backup.log

root@vm:~# cat /backup/backup.sh
#!/bin/bash
NOW='date +%s'
tar cvzf '/backup/www_backup_$NOW.tar.gz' /var/www/html/

root@vm:~# ls -l /backup/*gz
-rw-r--r-- 1 root root 539 Apr  4 17:02 '/backup/www_backup_$NOW.tar.gz'
```

1. 這個 crontab 的設定會在什麼時間條件下執行 (4pt)?

   According to the script above, when is the command in crontab executed?

2. crontab 中的 `2>> /var/log/backup_err.log` 有什麼效果 (4pt)?

   What's the purpose of `2>> /var/log/backup_err.log` in crontab?

3. 當你直接在 terminal 輸入 `/backup/backup.sh`，顯示 `bash: /backup/backup.sh: Permission denied` 但 crontab 卻正常執行。

   If you execute `/backup/backup.sh` directly in the terminal, and it shows `bash: /backup/backup.sh: Permission denied`. However, crontab works correctly.

   a. 請問主要問題是什麼 (4pt)？

      What may be the main problem?

   b. 需要下什麼指令解決使 `backup.sh` 可以直接執行 (4pt)？

      Write a command so that we can execute `backup.sh` directly.

4. 修復上述問題完並執行 `backup.sh` 後，你發現 tar.gz

   檔案並沒有加上日期，請問要修改何處使得執行 script 後 tar.gz

   檔名包含時間資訊(只需寫出有問題的部分即可)(4pt)　？

   After fixing the above issues, you found that the filename of tar.gz doesn't come with a date. Fix the script so that the filename of tar.gz contains information of time. (Just fix the wrong part of the script)

情境二 docker setup

我今天有個服務需要使用 mysql 作為資料庫，因此我將資料庫使用 docker 進行容器化，以下是我的 Dockerfile 與我自訂的 mysql 設定檔。

I have a service today that needs to use mysql as the database, so I use docker to containerize the database. The following is my Dockerfile and my custom mysql configuration file.

Dockerfile

```
FROM mysql:8
ENV MYSQL_ROOT_PASSWORD=root
ENV MYSQL_DATABASE=short_url
EXPOSE 3306
```

custom.cnf

```
[mysqld]
sql_mode='STRICT_TRANS_TABLES,NO_ZERO_IN_DATE,NO_ENGINE_SUBSTITUTION'
```

根據查官方文件，mysql 的設定檔放在 `/etc/mysql/conf.d/custom.cnf`。今天我想要將我本地的自訂設定檔(位於 `./mysql/custom.cnf`)同步至容器內，以及將容器內的 3306 port 與 host 機上的 3306 port 做 port forwarding (請使用預設 tcp)，並且為了避免直接將資料庫開在 0.0.0.0 讓任何人皆可存取造成資安風險，請將其設定為只能透過 IP 127.0.0.1 存取。

According to the official documentation, the mysql configuration file is placed in `/etc/mysql/conf.d/custom.cnf`. Today I want to synchronize my local custom configuration file (located in `./mysql/custom.cnf`) with the container, and perform port forwarding between the 3306 port of the container and the 3306 port of the host machine (please use the default tcp). To avoid potential information leak, we shouldn't bind the address of the database on 0.0.0.0. Please set it to be accessible only through IP 127.0.0.1.

我要怎麼撰寫我的 `docker run` 指令呢？

(請注意參數大小寫差異，會照指令正確度給分，不必加上 sudo)

How do I write my `docker run` command? (Please pay attention to the difference in the case of the parameters, the points will be awarded according to the correctness of the instructions, no need to add sudo)

Hint：`docker run [OPTIONS] IMAGE [COMMAND] [ARG…]`；

請參考以下參數 (-v、–volume、–mount、-p)；

Refer to the following parameters (-v、–volume、–mount、-p)