Raspberry Pi Setup

Seneca | SCHOOL OF INFORMATION TECHNOLOGY
ADMINISTRATION & SECURITY

TERM	NAME – Sudent ID	COURSE CODE	WEIGHT
	DEV SONI – DASONI4	CSN105	8%

Lab Objectives

Upon completion of this lab, you will be able to perform the following:

- Install an operating system on a Raspberry Pi
- Connect to a Raspberry Pi using "SSH"
- Connect to a Raspberry Pi using VNC Viewer
- Secure a Raspberry Pi

Lab Materials

1. Pre-Lab Video: Explanation
2. Raspberry Pi
3. Computer with Windows operating system
4. Internet connection

Lab Instructions

- Enter your name and student ID above (Example: david – dtrinh)
- Answer questions and add screenshots into the corresponding textboxes
- Save the file on your computer for future reference
- Save the file again as a ".pdf" file
- Submit the PDF file for grading

Part 1: Image SD card

🛑 **Before working with any electronic equipment, wash your hands and discharge yourself of static electricity!**

Perform on Computer:

1. Download Raspberry Pi Imager [https://www.raspberrypi.org/downloads/]
2. Install the Raspberry Pi Imager on the computer
3. Connect the SD card to the computer
4. Launch Raspberry Pi Imager
5. Select the recommended operating system
6. Select the SD card to image
   ⚠️ **This step will erase all data on the card!**
7. Confirm by clicking the "WRITE" button

Part 2: Enabling SSH

Perform on Computer:

1. Keep SD card connected to computer
2. Navigate to the SD card drive
   ⚠️ **If prompted, DO NOT FORMAT your SD card!**
3. Create an empty file called "ssh" (case sensitive)
   ⚠️ **Make sure this file does not have any file extensions!**
4. Remove SD card from computer

Part 3: Assigning IP Address to Raspberry Pi

We will attempt to assign an IP address to the Raspberry Pi. Depending on your configuration, follow the steps accordingly.

Scenario 1: You can connect the Raspberry Pi to your computer using a network cable

Video: Enabling Internet Connection Sharing (ICS)

We will be using the computer to share its internet connection with the Raspberry Pi. The computer's wireless adapter will need to be configured to allow sharing with its network adapter. This allows the Raspberry Pi to be part of the computer's network.

Perform on Computer:

1. Launch the network connections to view all network adapters on the computer
2. Locate the **wireless network adapter** and view the properties
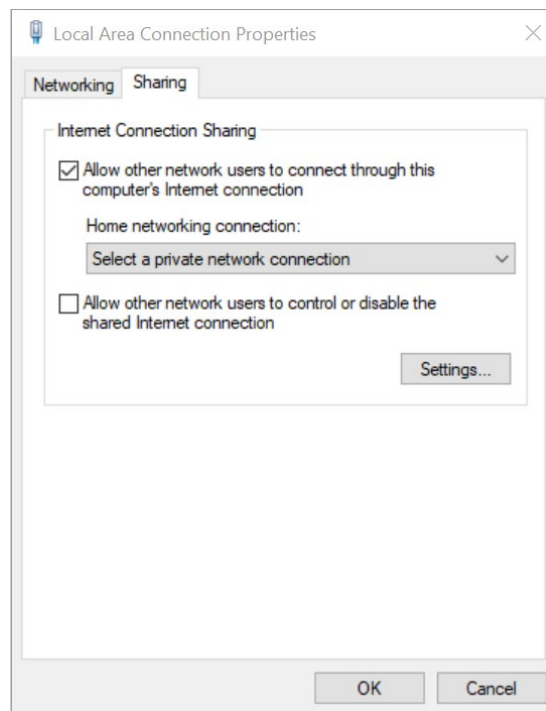3. Enable the internet sharing on the network adapter

Image may be slightly different

4. Select the ethernet network adapter associated with the computer's network port
5. Save the changes
6. Navigate to the ethernet network adapter associated with the computer's network port and confirm an IP address was statically assigned under the TCP/IPv4 properties
    ⚠️ **If no IP address was assigned, try disabling the internet connection sharing on the wireless adapter, save the settings, then re-enable the setting on the wireless adapter.**
7. If a static IP address was assigned, write down the IP address and Subnet mask

Scenario 2: You can connect the Raspberry Pi to your router

If you have access to your router and can log into the networking device, we can connect the Raspberry Pi directly to the router using the network cable. The router will assign an IP address to the Raspberry Pi.

Part 4: Powering on Raspberry Pi

🛑 **Do not connect the power adapter to the Raspberry Pi until instructed.**

Perform on Raspberry Pi:

1. Put the SD card into the Raspberry Pi
2. Connect one end of the network cable into computer
3. Connect the other end of the network cable into Raspberry Pi
4. Connect the power adapter
5. The lights on the Raspberry Pi should turn on

Part 5: Obtaining IP Address of the Raspberry Pi

The Raspberry Pi will obtain an IP address automatically either from the Internet Connection Sharing or the Router. This will be an IP address in the same network as the computer (example: 192.168.137.1). The Raspberry Pi's IP address will be within the range 192.168.137.2 – 192.168.137.254. There are a few ways to determine the Raspberry Pi's IP address.

🛑 **The IP address may change which requires you to connect using a new IP address.**

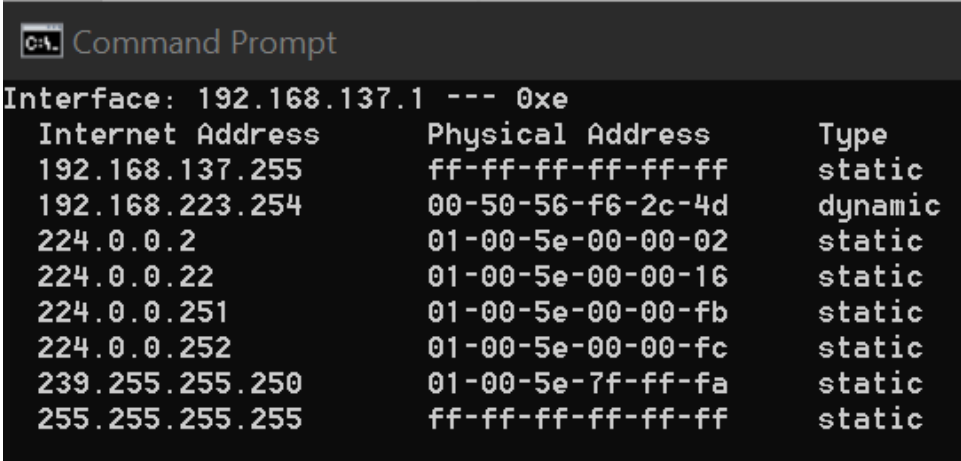### Scenario 1: Raspberry Pi is connected to the computer using a network cable

The "arp" command displays a listing of all the adapters with the internet address to physical address mappings for each adapter. Using a command prompt on the computer, the "arp" command may provide us the IP address of the Raspberry Pi.

Perform on Computer:

1. Open a command prompt and run the command:

        arp -a

2. Recall the Ethernet interface with the IP address is 192.168.137.1
3. Under that interface, look for any other device with an IP address in the range 192.168.137.2 – 192.168.137.254


```
Command Prompt
Interface: 192.168.137.1 --- 0xe
  Internet Address      Physical Address      Type
  192.168.137.255       ff-ff-ff-ff-ff-ff     static
  192.168.223.254       00-50-56-f6-2c-4d     dynamic
  224.0.0.2             01-00-5e-00-00-02     static
  224.0.0.22            01-00-5e-00-00-16     static
  224.0.0.251           01-00-5e-00-00-fb     static
  224.0.0.252           01-00-5e-00-00-fc     static
  239.255.255.250       01-00-5e-7f-ff-fa     static
  255.255.255.255       ff-ff-ff-ff-ff-ff     static
```

Image may be slightly different

Scenario 2: Raspberry Pi is connected to router

Perform on Computer:

Log into the router and navigate to the list of devices connected to the LAN network. Look for a device that resembles the Raspberry Pi in the list. The Raspberry Pi may or may not have a name listed in the device list. Finding the IP address of the Raspberry Pi may require some investigation of the devices connected to the network.

Image may be slightly different

Scenario 3: Monitor and mouse

Connecting a monitor and mouse to the Raspberry Pi will allow for us to view the graphical user interface (GUI) of the Raspberry Pi. There may be a few windows opened which will display the IP address of the Raspberry Pi.

1. Connect a computer mouse to the Raspberry Pi (USB)
2. Connect an external display to the Raspberry Pi (HDMI)
   o An adapter may be required if the display does not have an HDMI connector
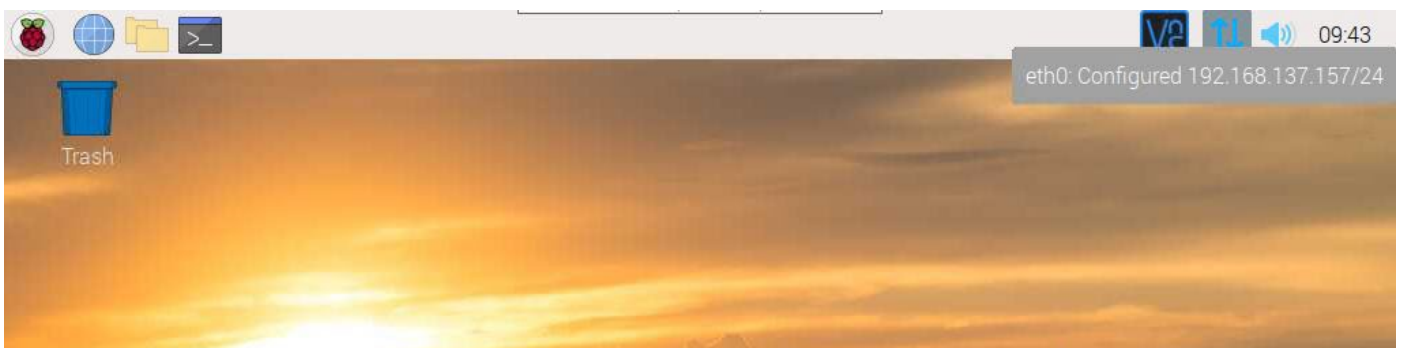3. Use the mouse to navigate and to find the IP address

Image may be slightly different

Part 6: Connecting to the Raspberry Pi with SSH

One method of connecting to the Raspberry Pi is using secure shell (SSH). This will provide a command line interface (CLI) on the Raspberry Pi. We will use an SSH client (Putty) to connect to the Raspberry Pi.

Perform on Computer:

1. Download Putty.exe [https://www.putty.org/]
2. Launch Putty and fill in the following fields:
   o Host Name (or IP address): IP address of the Raspberry Pi
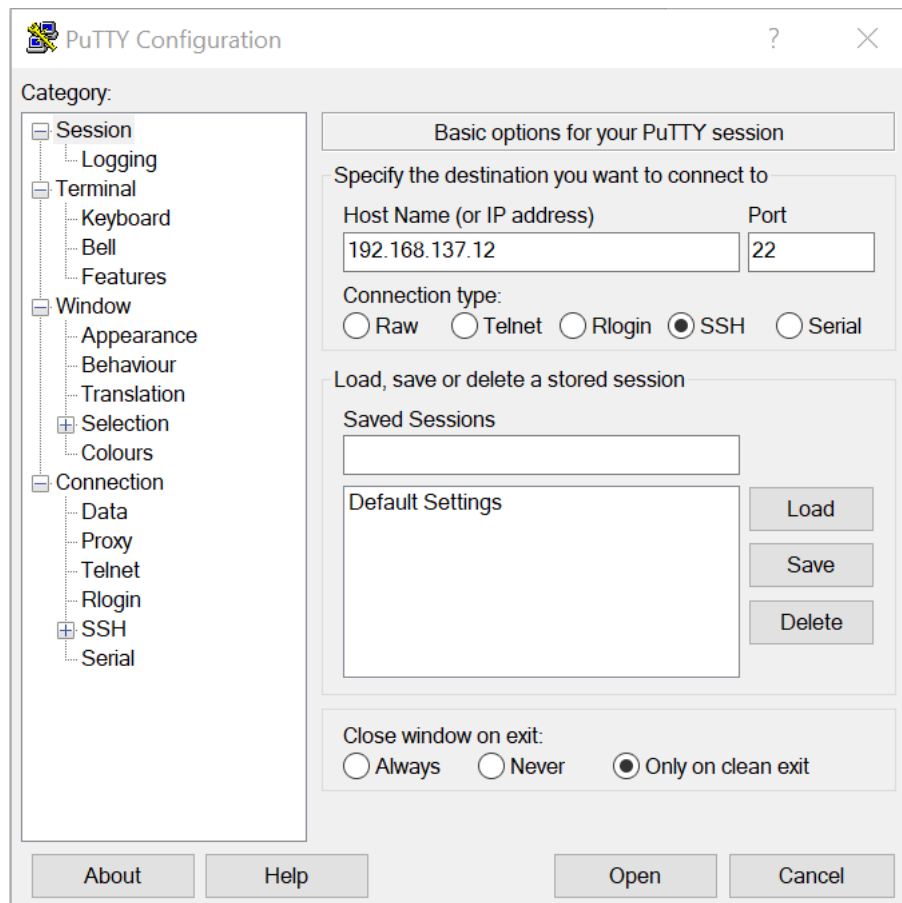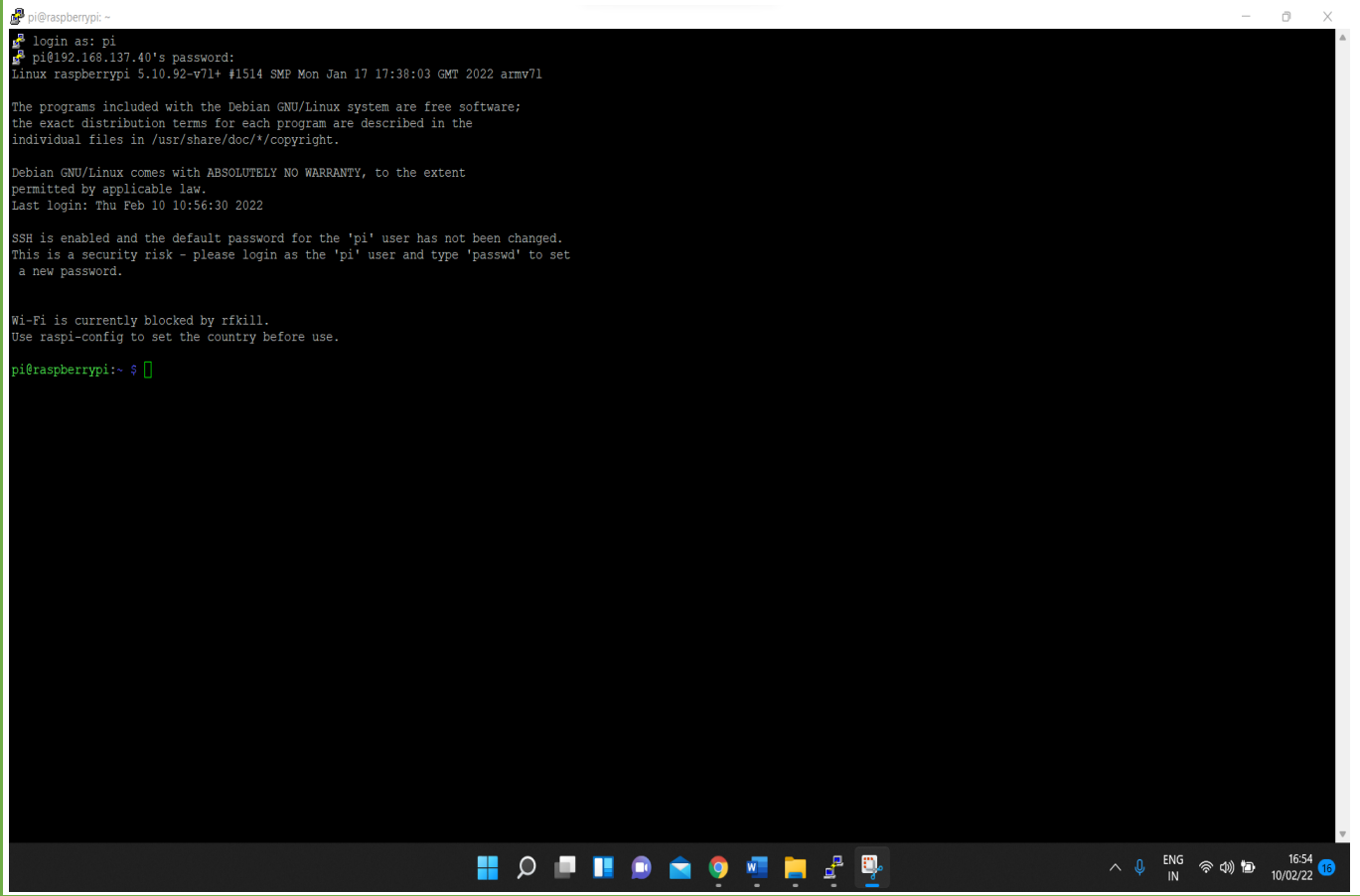   o Port: 22
   o Connection Type: SSH

Figure 3: Putty session

3. Launch the session by clicking "Open"
4. A prompt should appear where you can login using the default user "pi" credentials:
   o User: `pi`
   o Password: `raspberry`

Screenshot 6.0: SSH connection to Raspberry Pi [1 mark]

Part 7: Connecting to the Raspberry Pi with VNC Viewer

Another method of connecting to the Raspberry Pi is using VNC Viewer. This will provide a graphical user interface (GUI) on the Raspberry Pi. We will use Real VNC to connect to the Raspberry Pi.

1. SSH into the Raspberry Pi and login with "`pi`"
2. A successful login should result in a prompt

   ```
   pi@raspberrypi:~ $
   ```

3. Obtain the RealVNC package by issuing the command:

   ```
   sudo apt-get install realvnc-vnc-server
   ```

4. Open the "raspi-config" tool and enable VNC. Issue the command:

   ```
   sudo raspi-config
   ```

5. Select "Interfacing Options"
6. Select "VNC"
7. Confirm and Finish
8. Ensure the Raspberry Pi is rebooted for the changes to take effect.

```
sudo reboot
```

Perform on Computer:

9. Download VNC viewer [https://www.realvnc.com/en/connect/download/vnc/]
10. Launch VNC viewer and add a connection to the Raspberry Pi
11. Connect to the Raspberry Pi

Screenshot 7.0: VNC connection to Raspberry Pi [1 mark]
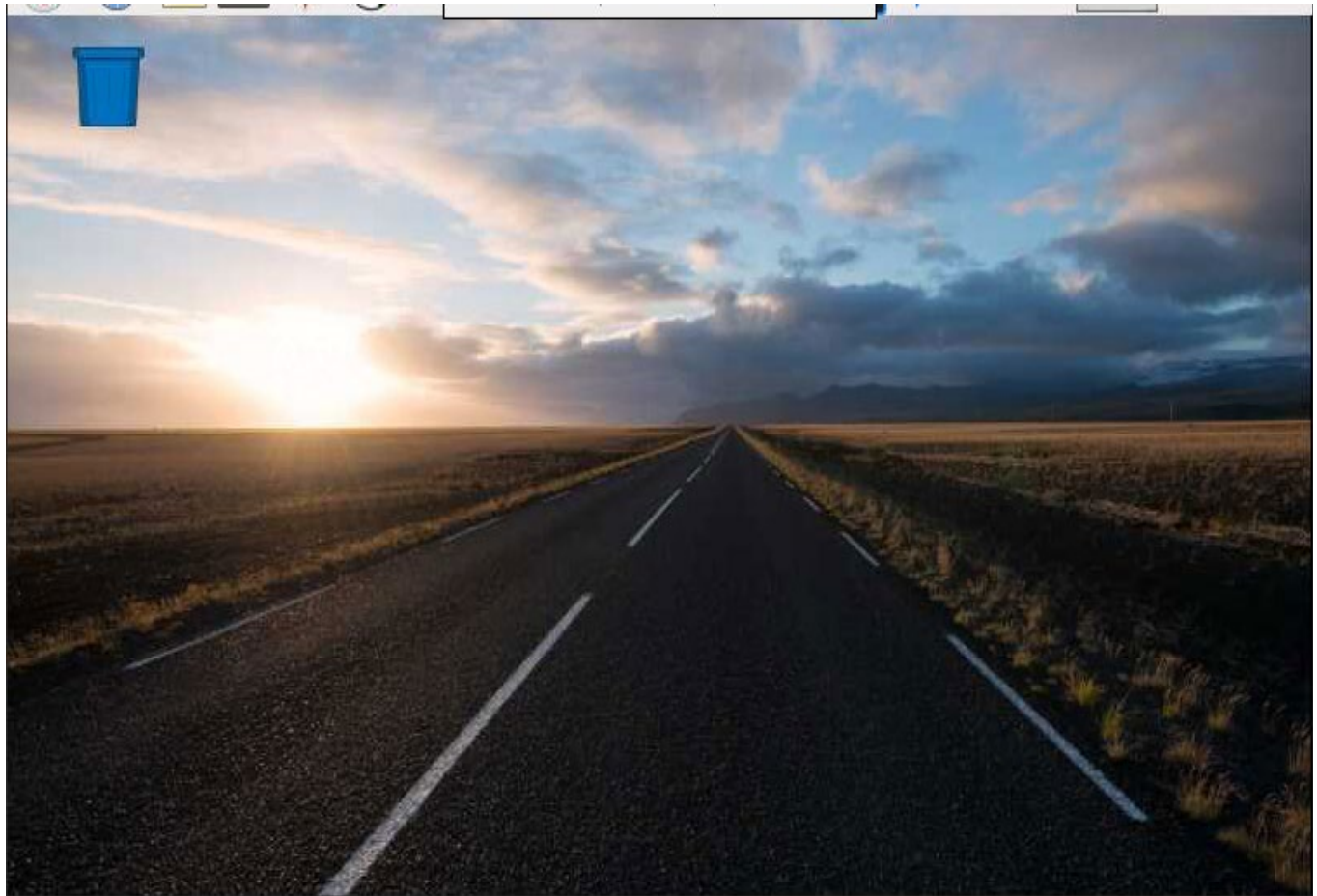
Part 8: User Accounts

By default, the normal account "pi" uses the password "raspberry". This account has full access to the Raspberry Pi. If it is not changed, anyone can gain full access to the Raspberry Pi.

1. SSH into the Raspberry Pi and login with "`pi`"
2. Type the command:

    ```
    passwd
    ```

3. Create a new password
    ⚠ **Make sure to remember the password!**
4. Try the new password by closing the SSH session and logging back in with "`pi`"

It is best practice to not log into a system with a "`root`" account or also known as an "administrator" account unless it is necessary. Logging in with a regular user account is recommended and only elevating the rights when needed. We have been logging in with a normal user account "`pi`" and elevating the rights by using commands with "`sudo`" when needed.

We can create our own normal account like "`pi`" which will allow us to personalize the account.

Perform on Raspberry Pi:

5. SSH into the Raspberry Pi and login with "`pi`"
6. Type the command:
    🛑 **Enter your Seneca userID instead of "`david`" (Example: dtrinh)**

    ```
    sudo adduser david
    ```

    ⚠ **Make sure to remember the password!**
7. For user "`david`" to have access to "`sudo`", we will add "`david`" to the "`sudo`" group:

    ```
    sudo usermod -a -G sudo david
    ```

8. To confirm the user has been added to the group:

    ```
    more /etc/group | grep "sudo"
    ```

    o The output should display both user names such as `sudo:x:27:pi,David`
9. To confirm the user can "`sudo`", switch to user "`david`" and issuing a command:

    ```
    su david

    sudo -l
    ```

    o Enter password
    o A prompt should appear listing the allowed commands for the user

Screenshot 8.0: Result of "`sudo -l`" [1 mark]

```
dasoni4@raspberrypi: /home/pi
pi@raspberrypi:~ $ sudo usermod -a -G sudo dasoni4
pi@raspberrypi:~ $ more /etc/group | grep "sudo"
sudo:x:27:pi,dasoni4
pi@raspberrypi:~ $ su dasoni4
Password:
dasoni4@raspberrypi:/home/pi $ sudo -l

We trust you have received the usual lecture from the local System
Administrator. It usually boils down to these three things:

    #1) Respect the privacy of others.
    #2) Think before you type.
    #3) With great power comes great responsibility.

[sudo] password for dasoni4:
Matching Defaults entries for dasoni4 on raspberrypi:
    env_reset, mail_badpass,
    secure_path=/usr/local/sbin\:/usr/local/bin\:/usr/sbin\:/usr/bin\:/sbin\:/bi
n,
    env_keep+=NO_AT_BRIDGE, env_keep+="http_proxy HTTP_PROXY",
    env_keep+="https_proxy HTTPS_PROXY", env_keep+="ftp_proxy FTP_PROXY",
    env_keep+=RSYNC_PROXY, env_keep+="no_proxy NO_PROXY"

User dasoni4 may run the following commands on raspberrypi:
    (ALL : ALL) ALL
dasoni4@raspberrypi:/home/pi $ 
```

To further secure the Raspberry Pi, we can require a password whenever "`sudo`" is used.

10. SSH into the Raspberry Pi and login with "`pi`"
11. Type the command:

    ```
    sudo nano /etc/sudoers.d/010_pi-nopasswd
    ```

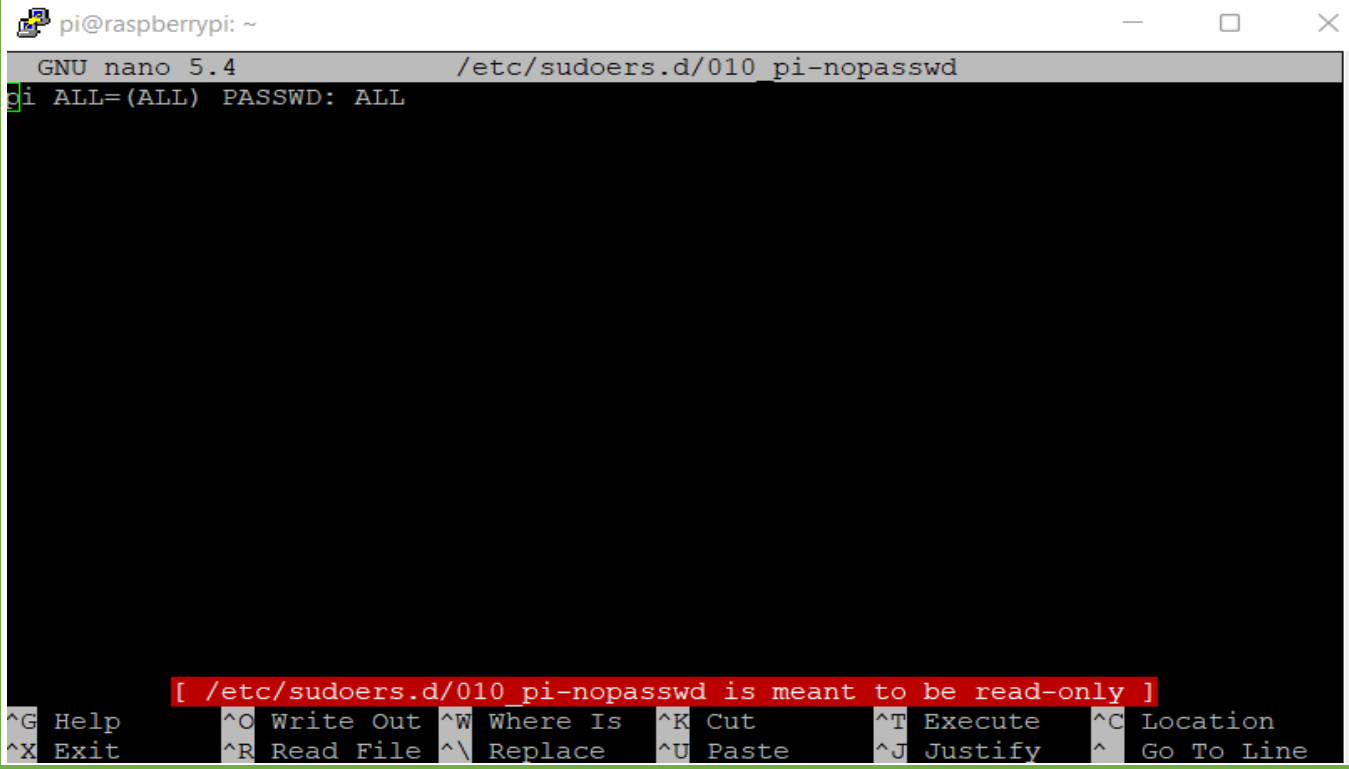12. Modify the entry by removing "NO" from "NOPASSWD"

    ```
    pi ALL=(ALL) PASSWD: ALL
    ```

13. Save the file and exit the program
14. Try the new configuration by issuing the command:

    ```
    sudo nano /etc/sudoers.d/010_pi-nopasswd
    ```

15. You should be prompted for "`pi`" password

Screenshot 8.1: Result of "`sudo nano /etc/sudoers.d/010_pi-nopasswd`" **[1 mark]**

```
pi@raspberrypi: ~                                              —    □    ✕
  GNU nano 5.4                    /etc/sudoers.d/010_pi-nopasswd
pi ALL=(ALL) PASSWD: ALL




















                 [ /etc/sudoers.d/010_pi-nopasswd is meant to be read-only ]
^G Help        ^O Write Out ^W Where Is  ^K Cut       ^T Execute   ^C Location
^X Exit        ^R Read File ^\ Replace   ^U Paste     ^J Justify   ^  Go To Line
```

⚠️ **For this course, revert the "`sudo`" settings back to the original setting.**

Part 9: Securing SSH

Using SSH is convenient when working with the command line. Since it is convenient, we want to secure SSH from its default settings to prevent others from attempting to connect to our Raspberry Pi. Some ways to secure SSH includes restricting user access, modifying the default port, and using key-based authentication. We will examine the first 2 methods.

Restricting user access

By default, any user account can SSH into the Raspberry Pi. We can restrict access to only particular user accounts by modifying the /etc/ssh/sshd_config file.

1. SSH into the Raspberry Pi and login with "`pi`"
2. Type the command:

        sudo nano /etc/ssh/sshd_config

3. Add the following line at the end of the file:

        AllowUsers pi

4. Save the file and exit the program
5. Confirm the entry was saved by issuing the command:

```
cat /etc/ssh/sshd_config
```

   The last line should be what we entered

6. Restart the SSH service for the changes to take effect:

```
sudo systemctl restart sshd
```

7. Close the Putty session and login with your other normal account (Example: `david`)

Screenshot 9.0: SSH into Raspberry Pi with your user account [1 mark]

> **If all our classmates were part of a group called "CSN105", explain how you would configure the permissions to allow everyone except your user account to SSH into the Raspberry Pi. [Hint: AllowGroups] [1 mark]**
>
> The configuration of the permission to allow everyone from group CSN105 except my user account to SSH into the Raspberry Pi is :-
> AllowGroups CSN105

Modifying Default Port

The default port used for SSH is port 22. We can change this port by modifying the `/etc/ssh/sshd_config` file.

8. SSH into the Raspberry Pi and login with "`pi`"
9. Type the command:

```
sudo nano /etc/ssh/sshd_config
```

10. Modify the line "#Port 22" to the following:

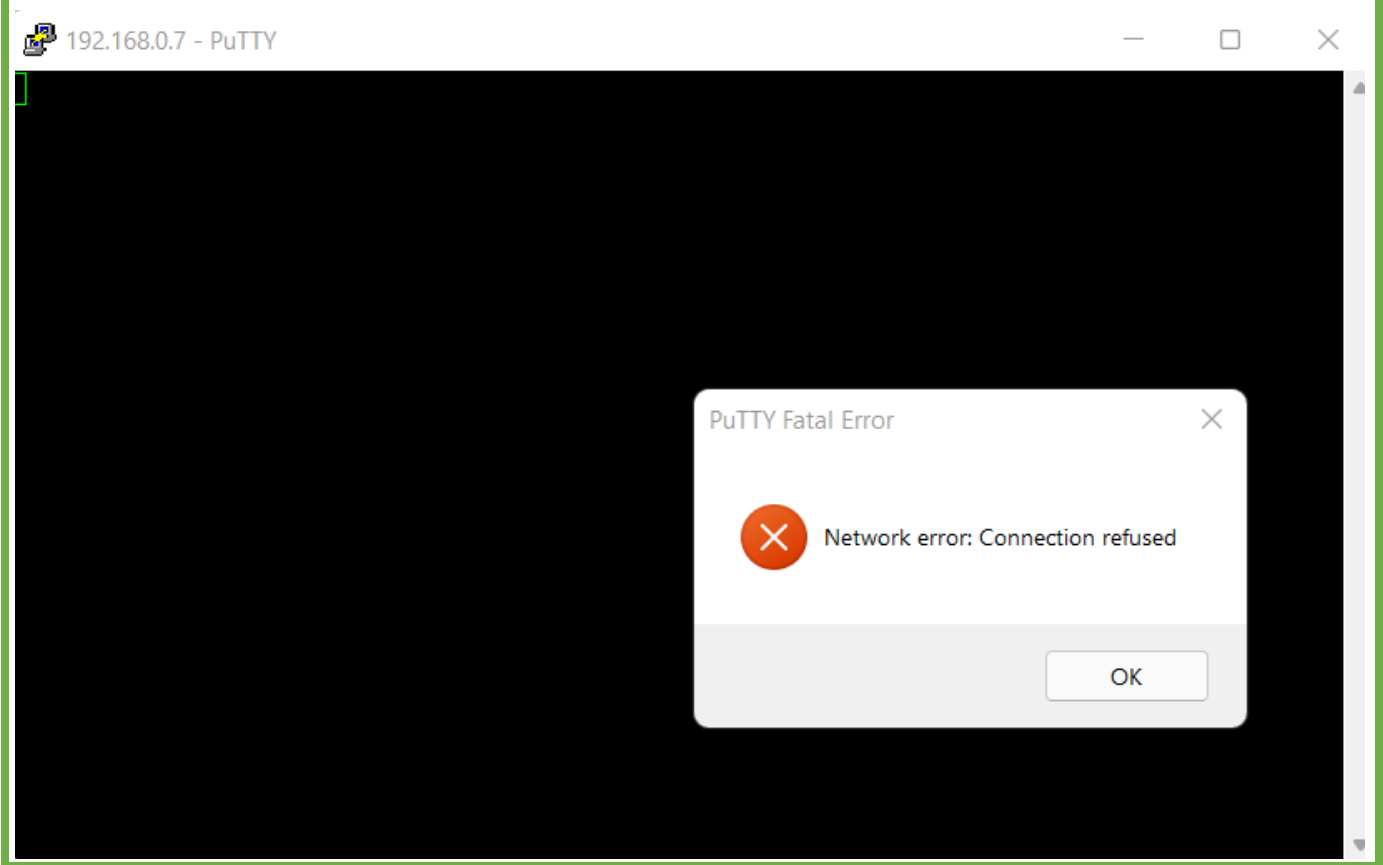🛑 **Enter the LAST 4 digits of your Student # instead of "XXXX" (Example: 0178)**
   o port XXXX

   Make sure to remove the "#"

11. Save the file and exit the program
12. Restart the SSH service for the changes to take effect:

```
sudo systemctl restart sshd
```

13. Close the Putty session and attempt to launch an SSH session with port 22

Screenshot 9.1: SSH into Raspberry Pi with port 22 [1 mark]

If the FIRST 4 digits of your Student # was used as the port, explain how this would affect your Putty session. [1 mark]

If the FIRST 4 digits of our Student # is used as the port then we will be having some issues or fatal error while connecting with the Raspberry Pi SSH again.

Part 10: Updating Operating System

Updating the operating system is critical to minimize any security vulnerabilities. The Raspberry Pi's operating system and its software packages can be updated and upgraded.

⚠️ This process may take a long time to complete.

1. SSH into the Raspberry Pi and login with "`pi`"
2. To update the software packages, type the command:

       sudo apt update

3. To upgrade the software packages, type the command:

```
sudo apt full-upgrade
```