KENNESAW STATE UNIVERSITY

CPE 4040: Data Collection and Analysis

Lab 1: Getting Started with Raspberry Pi

Learning Objectives:

1. How to install OS and update packages in Raspberry Pi.
2. Learn the required tools to access Raspberry Pi.
3. Understand how to make a remote connection via SSH and Remote Desktop Connection.
4. Write and execute a Python program.

Lab Procedure:

Pre-Lab Preparation

Before coming to the lab, please prepare your Raspberry Pi at home by following the steps below (Steps 1 to 11), especially if you are setting it up for the first time.

1. What do you need before you start?

   (a) Raspberry Pi 3 or 4

   (b) Power supply adapter

   (c) Micro SD card (16+GB)

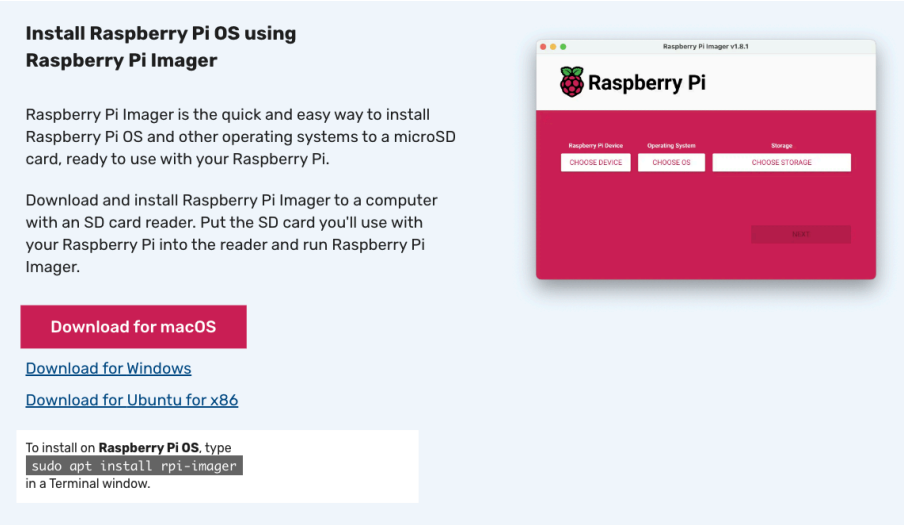
   (d) (Optional) Ethernet cable (Note: this might be needed in the lab)

   (e) (optional) USB Keyboard, mouse and HDMI monitor or TV

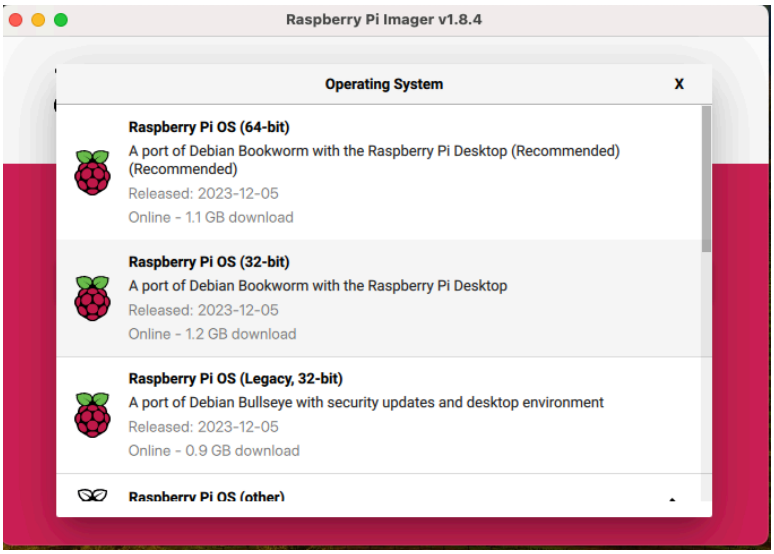
   (f) Download and install the following software on your laptop:

   - Putty (https://www.putty.org/) – Windows OS only
   - Advanced IP Scanner (https://www.advanced-ip-scanner.com/) – Windows OS only
   - Angry IP Scanner (https://angryip.org/) – Mac OS
   - WinSCP (https://winscp.net/eng/download.php) — Windows OS only

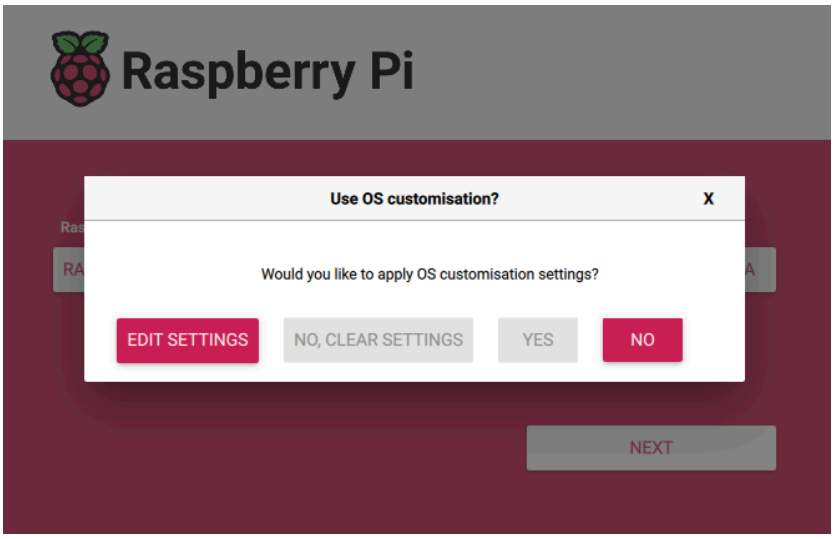
2. Go to https://www.raspberrypi.org/software/ and download Raspberry Pi Imager.



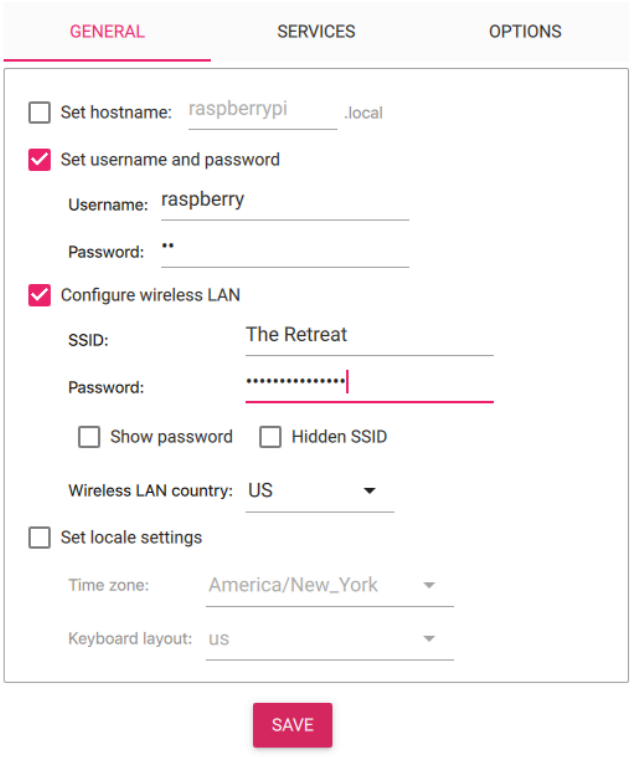
3. Insert an SD Card into your laptop and open Raspberry Pi Imager software. It is recommended to format SD card before use.
4. Click on "**Choose Storage**" button to find your SD card. Find "**Erase**" option on "**Choose OS**" menu and format the SD card.
5. After selecting your device type from the "**Choose Device**" button, click the "**Choose OS**" button and download the "Raspberry Pi OS (32-bit)" version



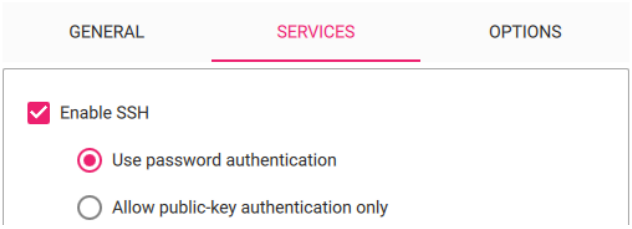
6. After selecting the Device, OS, and SD Card, click "**Next**". You will be prompted with regards to OS customization. Click on "**Edit Settings**".



7. Under the "**General**" tab, check the box to set a username and password. This will be used to log on to your Pi remotely over SSH later or via VCN later.
8. Under the "**General**" tab, check the box to configure wireless LAN and enter in your home WiFi network's information. When you boot up your Pi for the first time, it will automatically join this network.

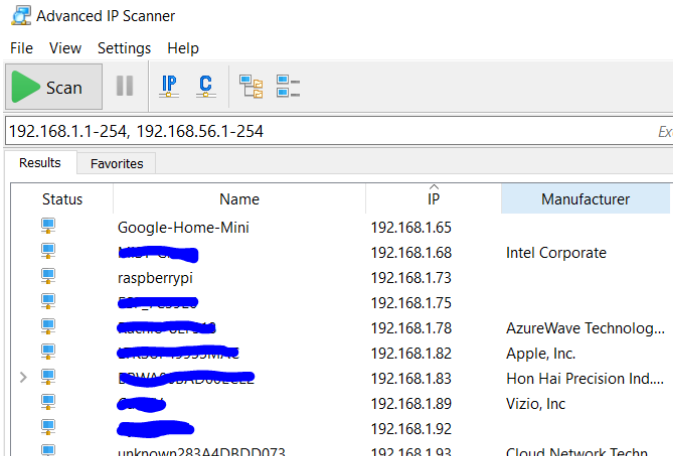


9. Under the "**Services**" tab, check the box to "**Enable SSH**", and click the option to "**Use password authentication**".



10. Save these options, and then click "Yes" when prompted with the same window in Step 6. Now, you can flash the SD card with the Raspberry Pi OS.
11. After the configuration is completed, remove the SD card from the laptop and insert it into Raspberry Pi. **Make sure the power adapter is not connected while inserting the SD card!**
12. Plug the USB power adapter to Raspberry Pi and power up the system.
13. After booting up, Raspberry Pi should be connected to Wi-Fi and SSH is enabled.
    - If you are using a Windows device, open **Advanced IP Scanner** and scan for the connected devices on the Wi-Fi network. You will see "raspberrypi" and IP Address (i.e. 192.168.0.100). Record the IP address. Use **Angry IP Scanner** for MacOS.

    Note: Please take a screenshot of your IP Scanner result and circle your Raspberry Pi on the list. This will be needed in the lab report.



Lab Session:

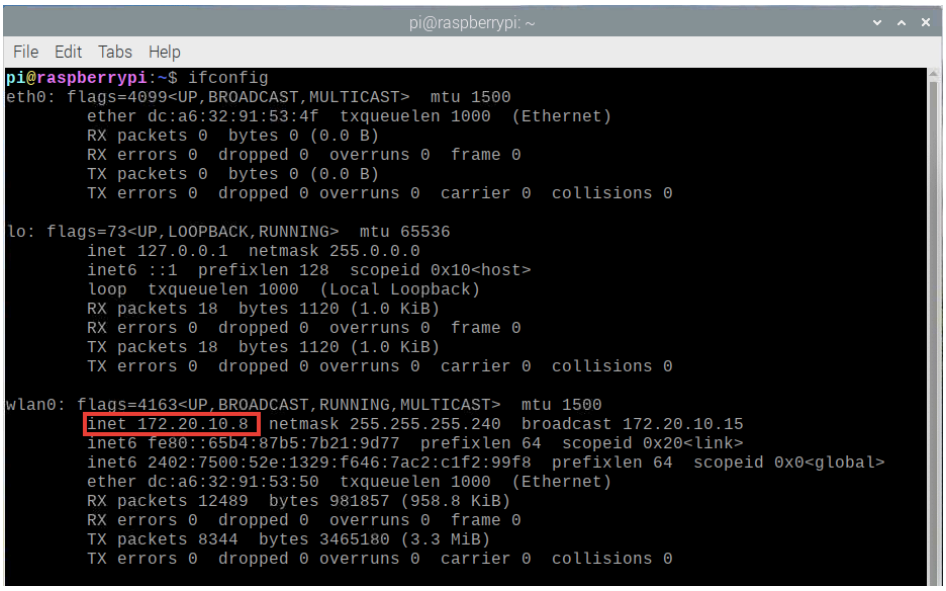
The following procedure will be executed in the laboratory.

1. The first step is to connect the Raspberry Pi to the internet wirelessly. In the past, students can do so by connecting to the KSU WiFi access point, *KSUGuest*, however, this option is no longer available due to new access restriction. Nonetheless, you can turn your laptop into a mobile hotspot by sharing the Internet connection reliably with the Raspberry Pi over Wi-Fi.

   Please follow the procedures in the tutorial, "**How to Share Your Internet via WiFi Hotspot**".

Alternative, you can also make your phone the mobile hotspot and share the LTE/5G data service with the Raspberry Pi.

2. The next step is to find the **IP address** of the Raspberry Pi.
   - In the GUI interface, click on the "Terminal" icon on the menu bar, a Terminal window will pop-up.
   - Type `ifconfig` and find the IP address (wlan0, see figure below). Write down the IP address for later use.



3. **SSH connection**:
   - For Windows OS, open Putty and enter the IP address of the Raspberry Pi into the IP address part. Click OK and make your SSH connection to Raspberry Pi.
   - You will be prompted with login name and password. For login name, enter `pi` and for password, enter `raspberry`.
   - In Mac OS, you need to open a Terminal app and type `ssh pi@ip_address`

4. **Software configuration**:
   a. Open the tool by entering `sudo raspi-config`
   b. Go to Interface Options and enable VNC, I2C, SPI and 1-Wire, one by one.
   c. Go to System Options menu and change hostname (by default raspberrypi) with your last name + initial of your first name (e.g., “jyiin”).
   d. Click Finish on the main menu and you will be asked to reboot. Click <Yes>.

   Note: Your SSH connection will be terminated while reboot.

5. After new login, you will see your new hostname on the command prompt. Next step: updating and installing Linux packages in the Raspberry Pi OS.
   - Type `sudo apt-get update` then Enter to update packages information.

- Type `sudo apt-get upgrade` then Enter to upgrade all installed packages

Note: This may take 10 to 15 minutes depending on the updates!

6. **Set up remote desktop connection:**
   - Install the following packages: `sudo apt-get install xrdp`
   - If you have problems getting remote connection work, open the terminal again and type `sudo apt-get remove xrdp`. Then try to install again.
7. **Remote Desktop Connection**:
   - Windows OS: open the **Remote Desktop Connection** app on your laptop, then enter the IP address of Raspberry Pi and click **Connect.** Once it is connected, enter the login name ("pi") and the password. The Raspberry Pi window GUI should now be displayed on the screen.
   - Mac OS: install the **Microsoft Remote Desktop** app from the App Store. Launch the application and follow the same procedure as described for the Windows OS.
   - Note: Alternatively, you can also use the **VNC Viewer** app, which is supported natively by Raspberry Pi. Visit the following link to download and install the app for your laptop: https://www.realvnc.com/en/connect/download/viewer/macos/
8. After you successfully make remote desktop connection, open a Terminal in Raspberry Pi and type `ifconfig` to acquire the same information as in the SSH connection.
9. **Write and Execute a Python Code**:
   - On an Raspberry Pi remote desktop terminal, open a Nano text editor and create a new file by entering `nano test.py`
   - Inside the Nano editor, compose a simple Python program that displays integers from 0 to 10 on the screen.
   - After writing the code, you will save your work and exit Nano by entering Ctrl+X, followed by 'Y' (for **Yes** to save) and exit Nano.
   - Finally, execute the code by entering `python test.py`

Lab Report:

Submit the report via D2L Assignment, in PDF format.

The report shall include the following:

1. In the pre-lab preparation session, please capture a screen shot of the IP scanner report that indicates the existence of your Raspberry Pi.
2. Capture a screenshot for each of the following steps (after finishing) in the lab session.
   - Step 1: Raspberry Pi connected to a mobile hotspot
   - Step 2: ifconfig output
   - Step 3: SSH connection
   - Step 4: Software configuration (show the Interface setup page)
   - Step 7: Remote desktop connection
   - Step 9: Python code execution
3. Know your Raspberry Pi:
   - What is the model of your Raspberry Pi, that is, 3, 4, Model B, etc.?
   - Capture a clear photo of your Raspberry Pi PCB board.
   - On the PCB photo, please highlight at least 7 key components and I/O ports on the board. Key components include SoC, WiFi, Bluetooth, memory, etc.
   - Which version of Python is on your Raspberry Pi? You should run `python –version` in the command line to find out.