EGR111 – Introduction to Computer Science (C Language)

Raspberry Pi Startup   Rev 1.1

Overview:

In this activity, you'll review the components of the Raspberry Pi single-board computer kit used in this course. The instructor will discuss its use, including how to connect remotely. You'll download and install the required software on your computer system and make your first remote connection into the system.

Prerequisites:

Prior to beginning the instruction provided in this lesson you must have completed the following:

1. C Programming Introduction.
2. Purchased the RPi kit from the NMC bookstore.
3. Verified that an Ethernet port is available on your computer system or purchased a USB-to-Ethernet adapter.

Performance Outcomes:

1. Identify and verify the components of the RPi Kit.
2. Download and install the required software on your computer.
3. Create a remote connection to the RPi Kit using VNC Viewer.

Resources:

1. Yahboom Raspberry Pi Kit
2. Bonjour Print Services for Windows (Required if you are using a Windows PC)
3. VNC Viewer

Materials:

1. EGR111 RPi Kit with custom OS installed (purchased from NMC bookstore)
2. Ethernet adapter (required if your computer does not have a built-in Ethernet port)

Directions:

1. Follow along with the instructor as the EGR111 RPi Kit is unboxed. A preview of this kit was provided in Week 01, and you must have purchased the kit in preparation for these lesson activities.

2. Review the image of the kit contents below and identify each item listed in the Bill of Materials that follows. Note: the fan was added later and is not shown.

Figure 1 EGR111 RPi Kit Contents

EGR111 Raspberry Pi Kit
Student Kit
1.01
7/11/2022

Part Name	Quantity	Unit of Measure	Procurement Type	Cost	Price
Raspberry Pi 4B 4Gb+	1	each	OTS	$ 150.00	$ 150.00
Micro SD card 32G with OS	1	each	OTS	$ -	$ -
Type-C power adaptor	1	each	OTS	$ -	$ -
Micro-HDMI cable	1	each	OTS	$ -	$ -
Network cable	1	each	OTS	$ -	$ -
Card Reader	1	each	OTS	$ -	$ -
Case	1	each	OTS	$ -	$ -
Fan	1	each	OTS	$ -	$ -
Heat sinks	1	each	OTS	$ -	$ -
				subtotal	$ 150.00

Figure 2 EGR111 RPi Kit Bill of Materials (BoM)

3. Review the contents of your kit to verify that you have each item.

4. Open the box containing the Raspberry Pi. Review the items shown in Figure 3 and identify each on your Raspberry Pi single-board computer.
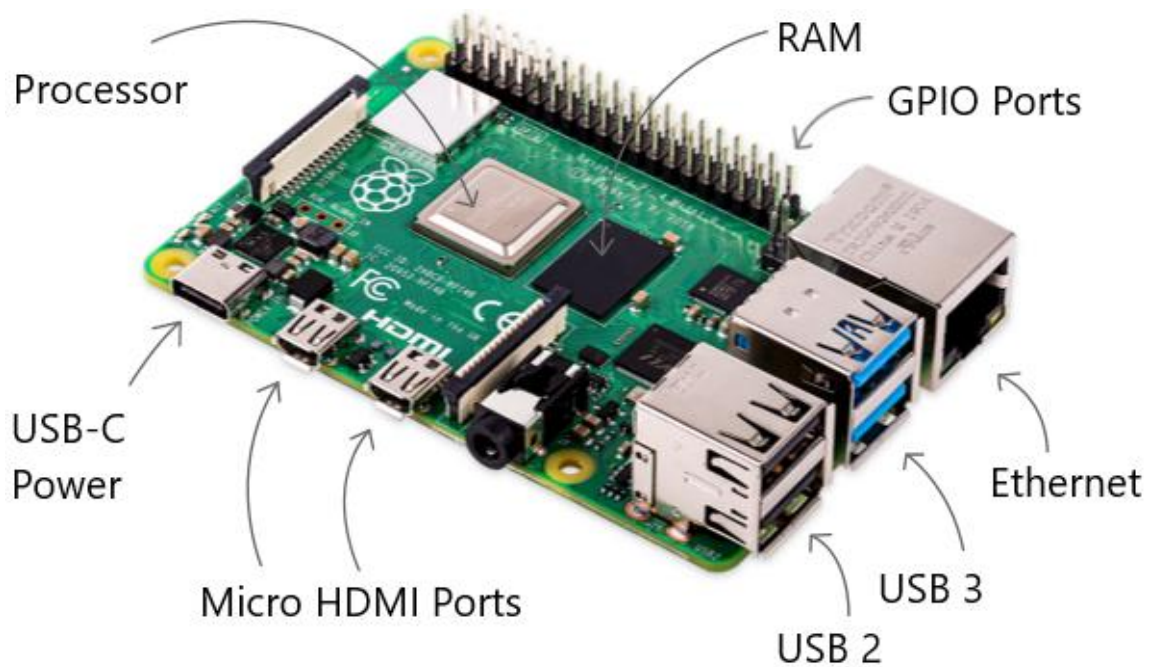
Figure 3 - Raspberry Pi Single-Board Computer

5. Locate the package of heat sinks in your kit. Remove the backing from the adhesive strip on the backside of each and press on to the three chips on the board as shown in Figure 4.
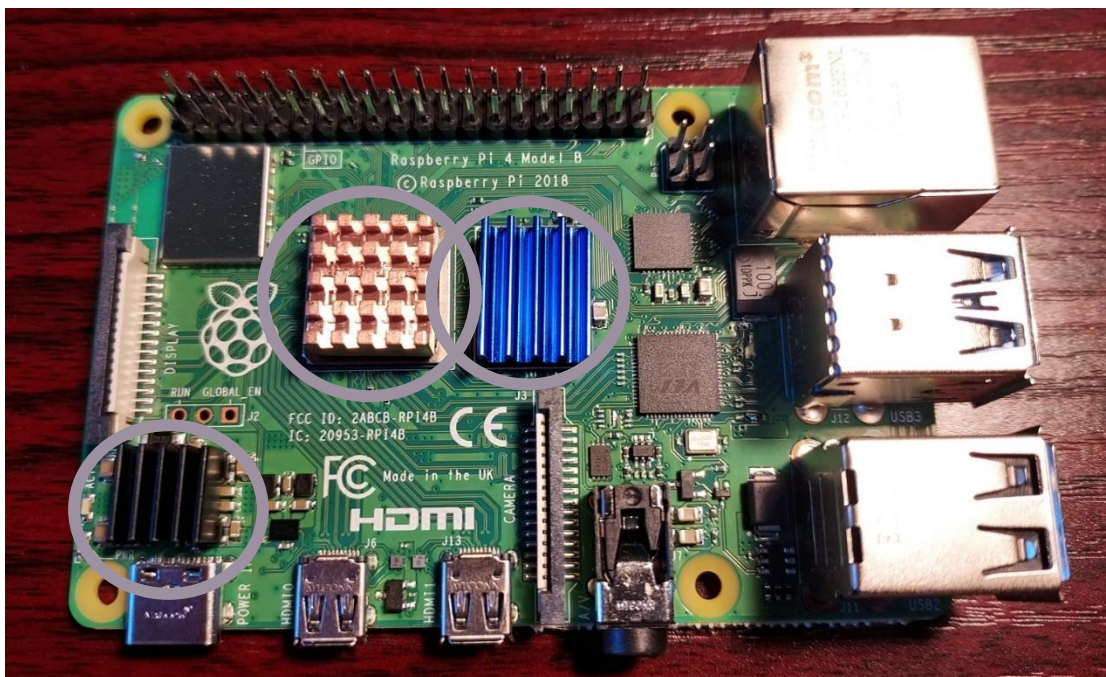

Figure 4 Raspberry Pi with Heat Sinks Installed

6. Locate the case. Insert the Raspberry Pi and snap the case closed. There are small screws provided to secure the Pi to the base of the case, but these are optional. The closed case provides a pressure fit that will be sufficient for the applications in this class.

Figure 5 RPi with Case

7. Kits were shipped with an optional fan. Use the four Phillips head screws to attach the fan to the top of the case.
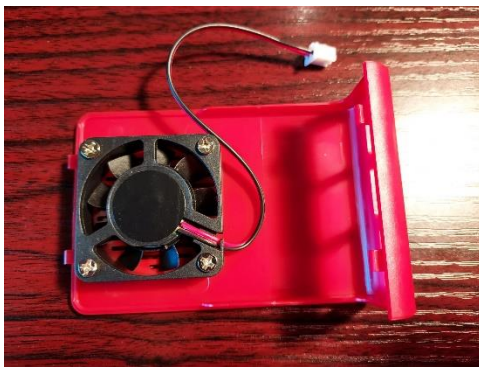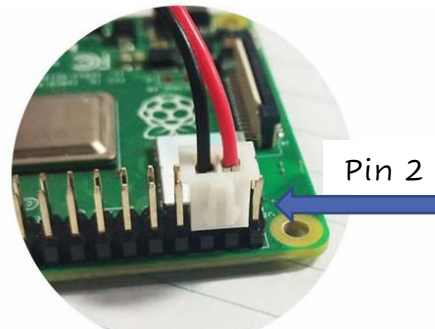

Figure 6 RPi with Optional Fan

8. Plug the fan connector into pins 4 and 6 on the GPIO header. Note these are the outer row of pins. The first pin is pin 2 and it is skipped. The connection is to +5 volts (pin 4) and ground (pin 6).

	Pin No.		
3.3V	1	2	5V
GPIO2	3	4	5V
GPIO3	5	6	GND
GPIO4	7	8	GPIO14
GND	9	10	GPIO15
GPIO17	11	12	GPIO18

Pin 2

9. The RPi operating system is stored on the micro-SD card. Remove the micro-SD card from the adapter and insert it into the RPi unit as shown below. Note the orientation of the SD card. The label is showing and the contacts on the opposite side face the RPi board.
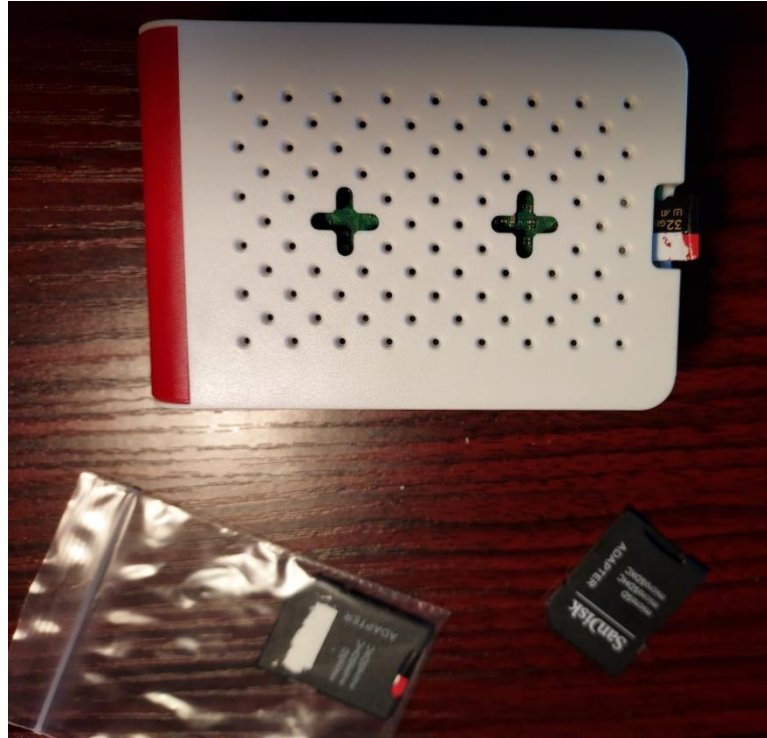

Figure 7 Micro SD Card Inserted in RPi

10. A USB adapter for the micro-SD card is included in the kit. This component is not typically required but is provided so that backups of the SD card can be made.

Figure 8 USB Micro-SD Card Adapter

11. A typical setup for a Raspberry Pi single-board computer is shown in Figure 9. Note the USB-C power connection in addition to the USB Dongle providing keyboard and mouse connectivity. A small HDMI monitor is displaying the Pi desktop and requires the Micro-HDMI cable included in your kit.
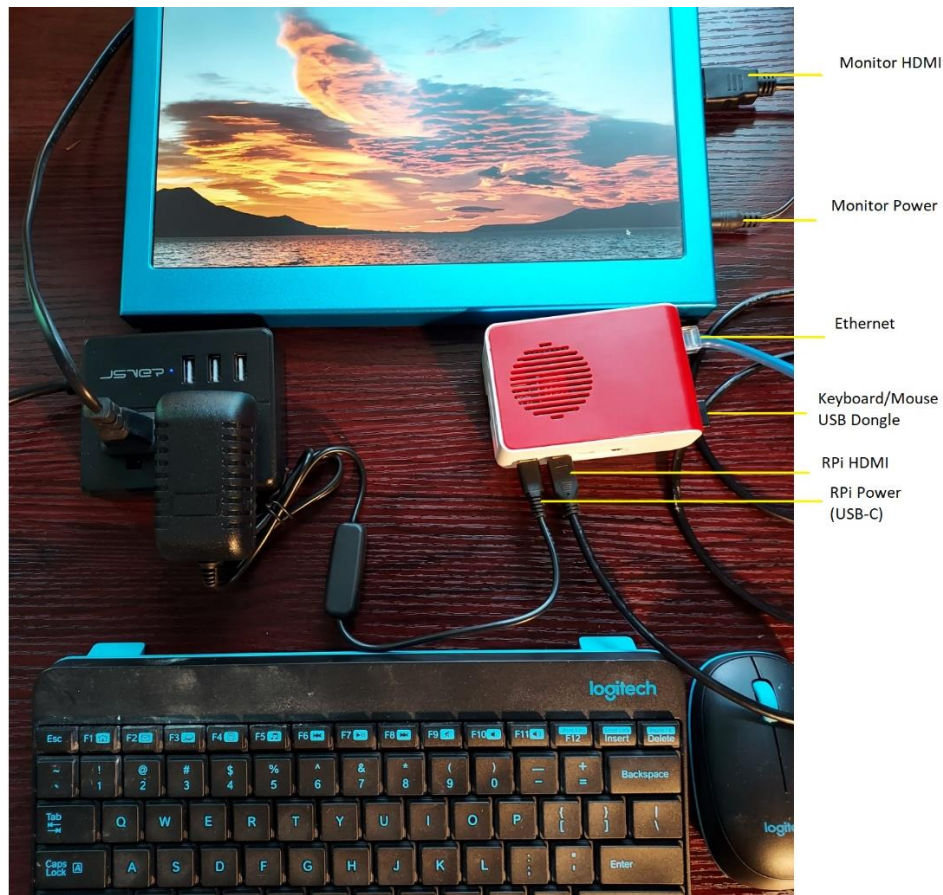
Figure 9 - RPi Single Board Computer Setup

12. In this class, we'll assume that you don't have a monitor, keyboard, or mouse. We'll connect to the Raspberry Pi remotely using a remote desktop service (VNC) running on the RPi. Initially, we'll connect to the RPi using the Ethernet cable provided. Eventually we'll connect using Wi-Fi. Connecting remotely to a Raspberry Pi that is running without a monitor and keyboard is referred to as "headless" mode.

13. The first step in making the remote connection is to connect the RPi to power and to your computer using the Ethernet cable provided.

6

Figure 10 - RPi with Power and Ethernet Connected

14. Connect the Ethernet cable to your computer. Recall that if your computer does not have an Ethernet port, a USB to Ethernet adapter is required like the one shown below.

Figure 11 Ethernet to USB adapter

15. You'll be creating a peer-to-peer network connection between your workstation and the Raspberry Pi. If you're using a Windows PC an additional software driver is required to make this type of connection. If you are on a PC, navigate to this Bonjour Print Services for Windows link. Download and install the driver.

16. You'll use VNC remote desktop software to provide the remote connection. The RPi system provided for you has the VNC server

7

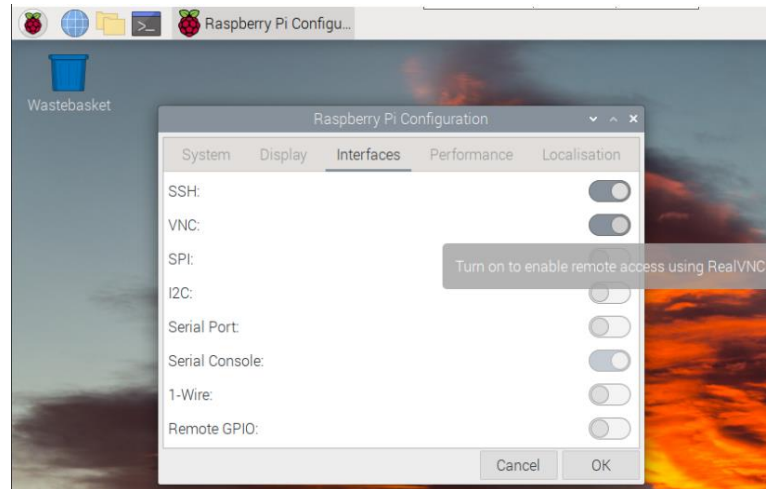feature enabled as shown below, but you must install the VNC client on your workstation.

Figure 12 Remote Desktop showing VNC Server Enabled

4. Open the VNC Viewer link on your workstation. Download and install the VNC Viewer client software. Just install the viewer software. The software is free, and you DO NOT need to sign up for additional software or services such as VNC Connect.

5. You're now ready to connect.
   a. Turn the power on to the RPi unit. Note the red LED indicating that power is applied and the flashing green LED light indicating activity.

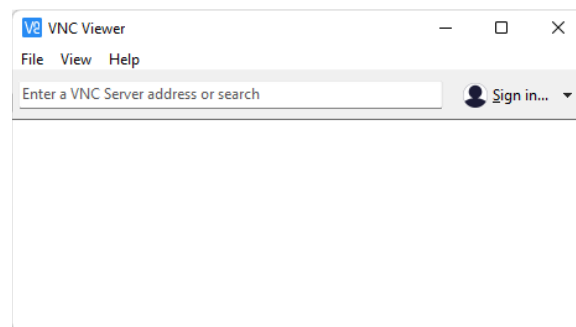   b. Open VNC on your workstation. The window below is shown.

Figure 13 VNC Client Window

   c. Enter the VNC Server address below. The RPI host name is raspberrypi. The .local is appended to the end due to the peer-to-peer network connection created over the Ethernet.

raspberrypi.local

d. You must provide credentials to create the remote connection. Enter **pi** as the user and **changeme** as the password. You'll continue to use pi as the user throughout the course. You'll change the password once we are connected.
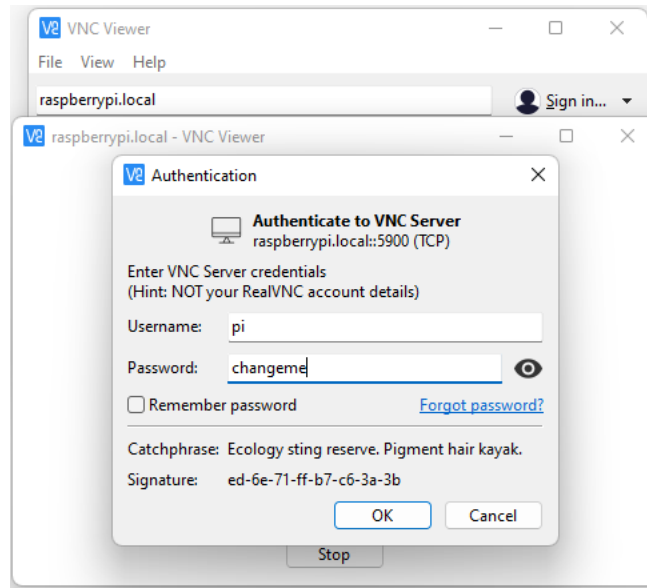

Figure 14 VNC Authentication
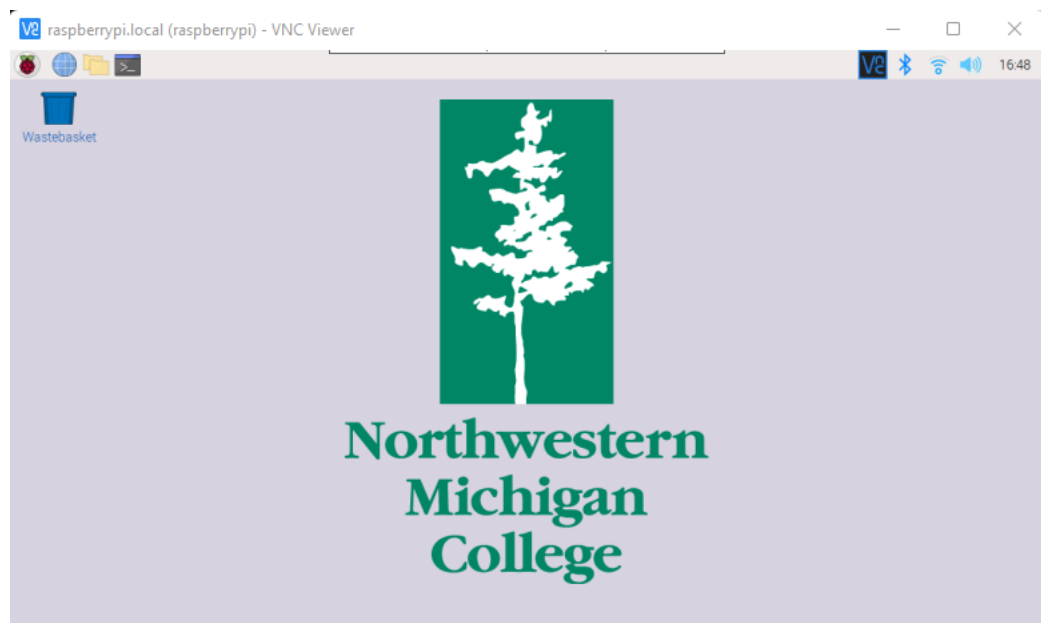
e. Click OK. The remote desktop is displayed.

Figure 15 RPi Remote Desktop using VNC Viewer

6. Change the initial *changeme* password to secure your system. Click the Raspberry in the top left corner and then click Preferences and then Raspberry Pi Configuration as shown below.
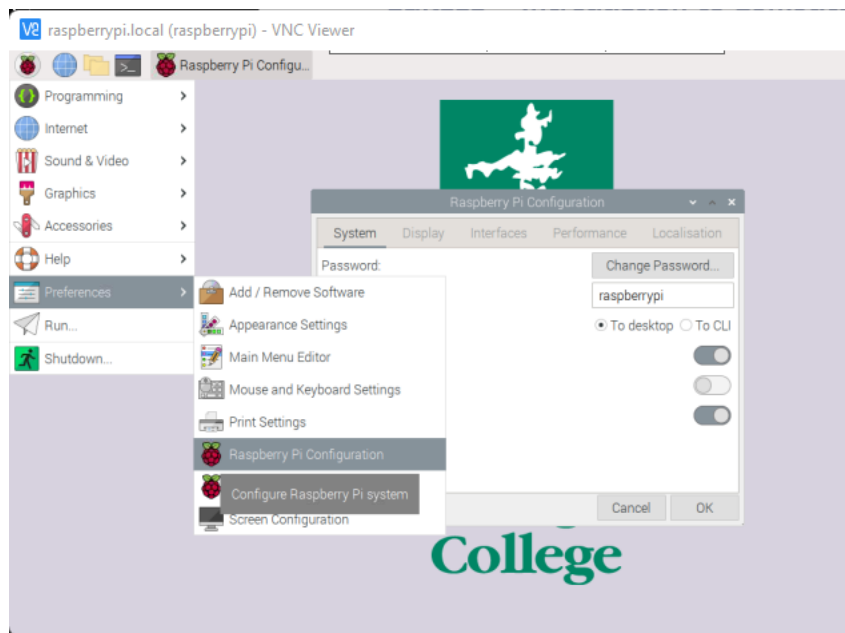

Figure 16 RPi Menu and Configuration

7. Click the Change Password button and enter your new password. Confirming the password will activate the OK button. Click OK and then close the configuration window. **NOTE:** *You must remember your password!* There is no administrative override or ability to reset. If you forget your password, you'll need to start with a new image of the operating system and reconfigure.
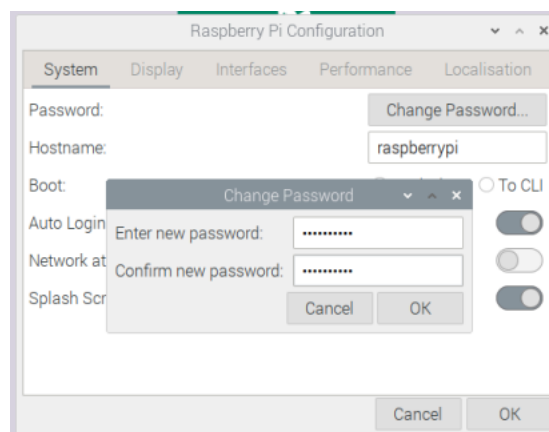

Figure 17 Change Password Prompt

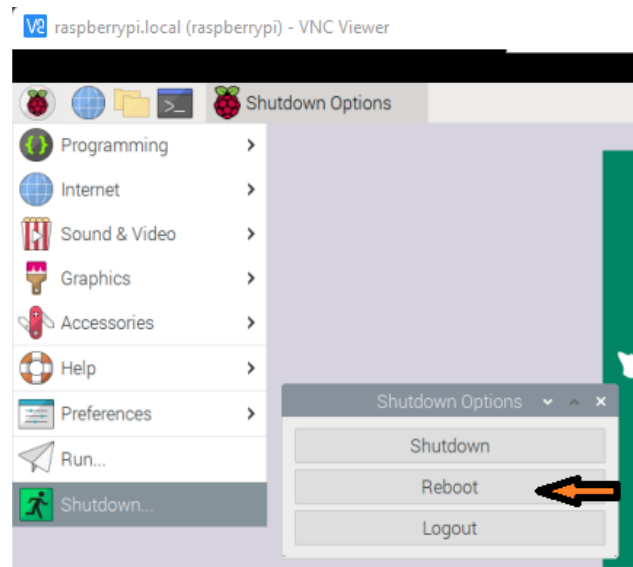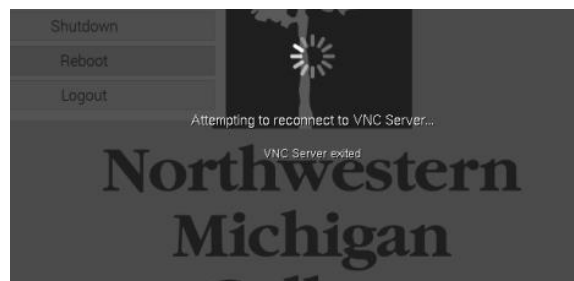8. Now that the password is updated. Restart the RPI using the menu as shown below.

Figure 18 Reboot using the RPi Menu

9. The VNC view will lose the connection and attempt to reconnect.

10. Once the RPi boots, the Authentication screen will be displayed again. Enter the new password, click the *Remember password* check box, and click OK. The remote desktop will display.
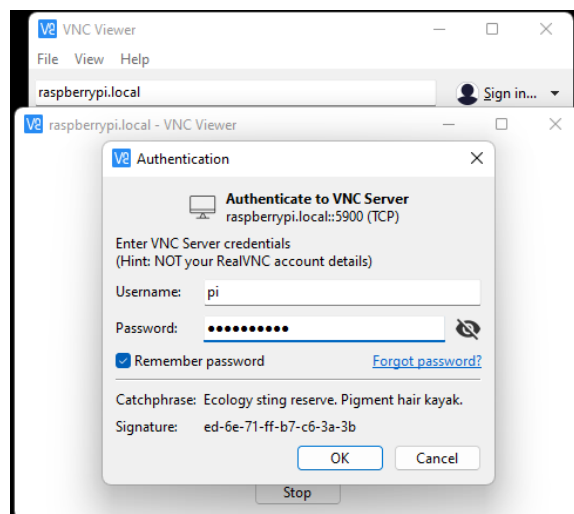

Figure 19 VNC Authentication with Remember Checkbox Ticked

11

11. Close the remote window and note that an icon representing the RPi local connection is now shown in the VNC client window. Click the icon to re-open the connection. Use the raspberrypi.local connection any time you have a direct connection to your RPi unit using the Ethernet cable.
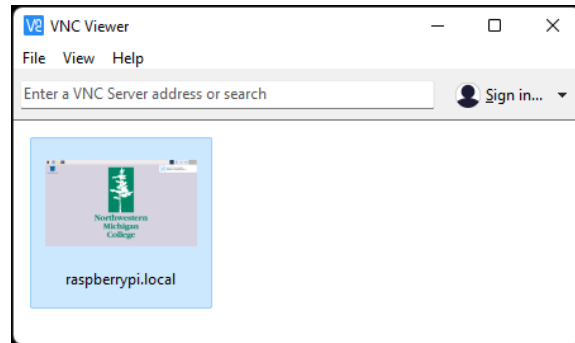

Figure 20 VNC Window with RPi Connection

12. It is possible to connect over your Wi-Fi access point if you are not using the NMC engtech network. Open the remote desktop if closed and click on the Wi-Fi tool on the taskbar in the upper righthand corner. Available Wi-Fi access points are shown. Figure 21 shows the Wi-Fi access points available in the instructor's home. The 5G connection is currently active.
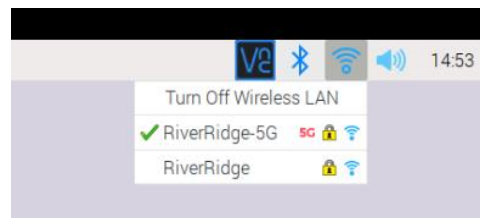

Figure 21 RPi Desktop showing Wi-Fi Access Points

13. If another access point is selected, you are prompted for the password (Pre-shared Key) as shown below. Enter your password to create the network.

Figure 22 RPi Desktop Prompting for Wi-Fi Password

12

14. Once the connection is made, the icon will update and hovering over the icon will display IP addresses associated with the wlan0 connection.
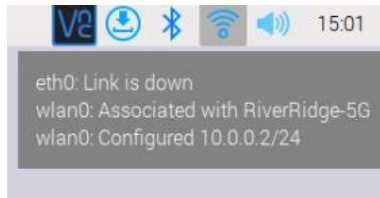

Figure 23 Wi-Fi Connection with IP Address Shown

15. Verify that you have access to the Internet by opening the Browser and navigating to Google.com.
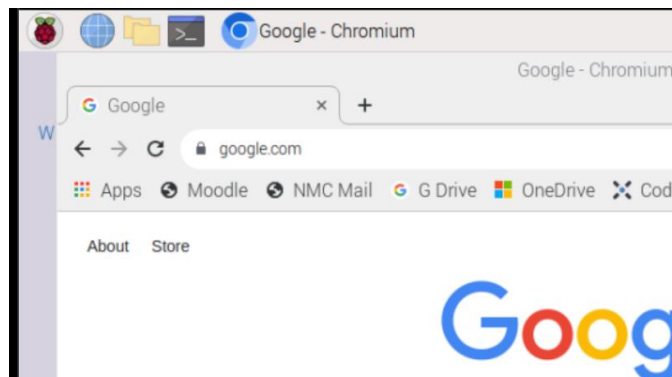

Figure 24 Google.com Opened in the Browser

16. If your workstation and the RPi unit are connected to the same network, then you'll be able to connect without the direct Ethernet connection.

17. Close the remote desktop and remove the Ethernet connection to the RPi.

18. Connect via your home or work network by entering **raspberrypi** as the host name. Again, *raspberrypi.local* is used when the direct Ethernet connection is made. Enter pi as the user and your password set previously. The remote desktop is displayed.
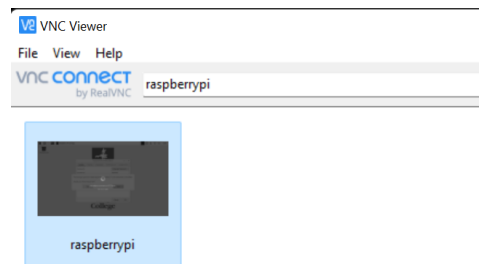

Figure 25 VNC Connection using Wi-Fi Network

19. The instructor will review the process for creating a screen capture image. See the Tools section on the Moodle page for tutorials.

20. Use the screen capture process to capture the following.
    a. The VNC client window on your workstation showing the *raspberrypi.local* icon and the *raspberry* icon if the Wi-Fi connection was available. Name the file **vnc_client.jpg**
    b. The RPi remote desktop showing Google in the browser window indicating that you were able to create the remote connection and the RPi unit has access to the Internet. Name the file **remote_desktop.jpg**

Assessments:

1. Submit the vnc_client.jpg and remote_desktop.jpg image to the Moodle link provided.