

GETTING STARTED USING RASPBERRY PI IN THE SHACK

(PART 1)

Jack Weaver – AA5VZ

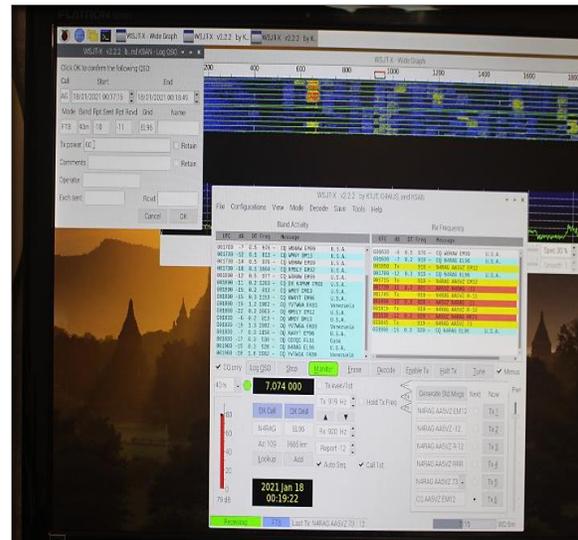
I love this hobby! Where else can you sit in a hotel room in Pittsburgh PA and enjoy a digital QSO on a laptop with a fellow Ham in France, using your transmitter & antenna in Texas via a Raspberry Pi computer connected to the internet? A strange thing to consider one's own signals passing overhead on their way to Europe and back!

December, 2017

INTRODUCTION

GETTING STARTED... MOVING FORWARD

- ▶ Assemble a Raspberry Pi Workstation
- ▶ Load the base Operating System (O/S)
- ▶ Install and Configure Ham Radio Apps
- ▶ Interface the Pi with your Station
- ▶ Get on the Air!



MY JOURNEY

The Raspberry Pi Alternative for WSJT-X

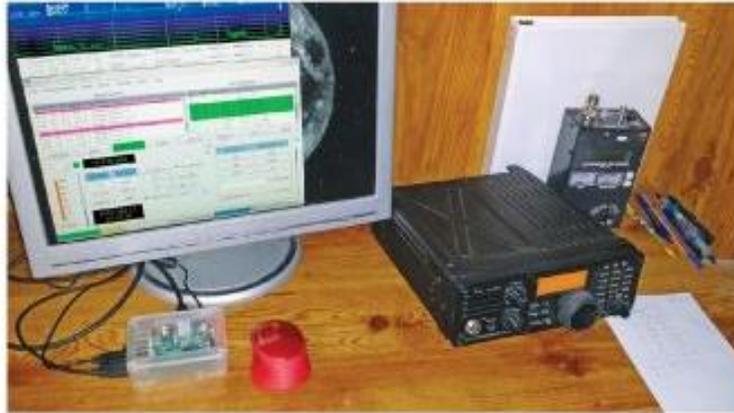
Turn an inexpensive microcomputer into a digital communication machine.

Thomas Kocourek, N4FWD

In the "Eclectic Technology" column in the April 2017 issue of QST, Chuck Kelly, W9MDO/VE1MDO, described a portable option for running WSJT-X digital mode software with a Raspberry Pi 3 microcomputer and a miniature LCD touchscreen. In this article, Thomas Kocourek, N4FWD, presents a similar solution, but with the emphasis on using the Pi as a dedicated home station computer for JT65, JT9, and WSPR — Ed.

As we slide into the oncoming solar minimum, it's no surprise that we're seeing an uptick in popularity for digital modes, such as JT65 and JT9, as well as the WSPR digital beacon mode. JT65 and JT9 can support contacts on the HF bands under conditions that would render other modes unusable. And for those interested in HF propagation studies, WSPR is ideal.

All three modes are available in the free WSJT-X software package, created by Dr. Joe Taylor, K1JT. In addition to



The author's station, with his Raspberry Pi 3 microcomputer at lower left, in its transparent case.

around your ham shack. However, here is a list for those starting from scratch:

- **A Raspberry Pi 3 microcomputer.**

For beginners, I strongly recommend a "kit," such as those offered by CanaKit (see Amazon and other sources), because these packages include almost everything you'll need, often including a case and power supply. Prices range

your monitor. Considering the small size of the Raspberry Pi, I'd recommend a lightweight cable to keep everything mechanically stable.

- **A USB "A-B" style cable.** This cable will link your Raspberry Pi to your interface or transceiver.

- **A keyboard and mouse.** To keep cabling to a minimum, I recommend a

MY JOURNEY

QST Article, July 2017
Thomas Kocourek,
N4FWD



MY JOURNEY

Raspberry Pi 3B

August, 2017



MY JOURNEY

Kenwood TS-590
USB Direct Audio Interface
Wireless Keyboard/Touchpad

August 2017



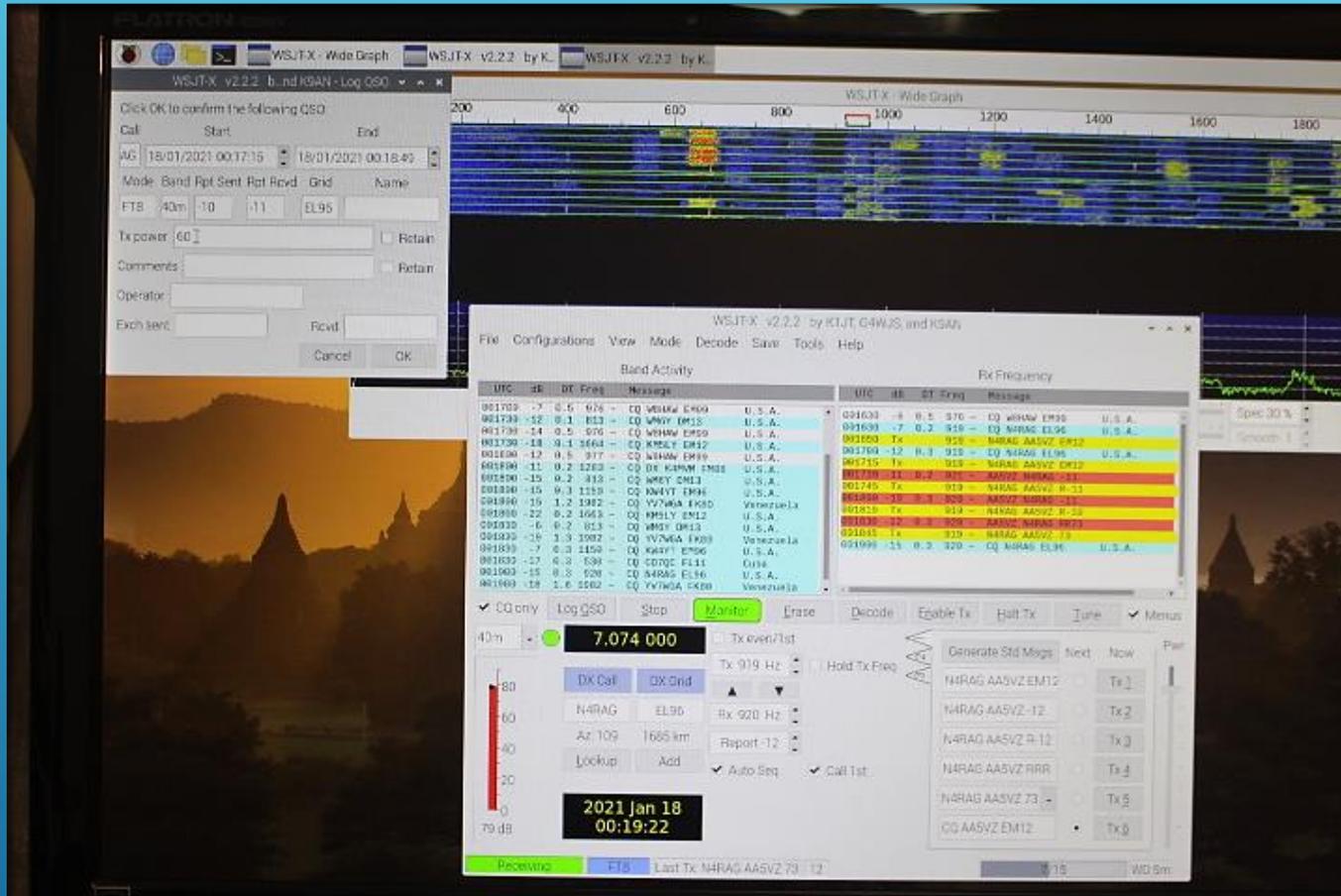
MY JOURNEY

Raspberry Pi-3B
WSJT-X App (Linux)
JT-65 Digital Mode

August 2017

MY JOURNEY

- ▶ FT-8 Digital Mode
- ▶ Raspberry Pi-4
- ▶ Kenwood TS-590
- ▶ USB Direct Audio Interface
- ▶ Wireless Keyboard/Mouse
- ▶ December 2020





MY JOURNEY

- ▶ NEXTION 3.5
- ▶ ZUM SPOT Hotspot – 70cm
- ▶ Raspberry Pi Zero-W
- ▶ Kenwood TH-74A HT
- ▶ DSTAR support

- ▶ December 2020

RASPBERRY PI

WHAT IS IT?

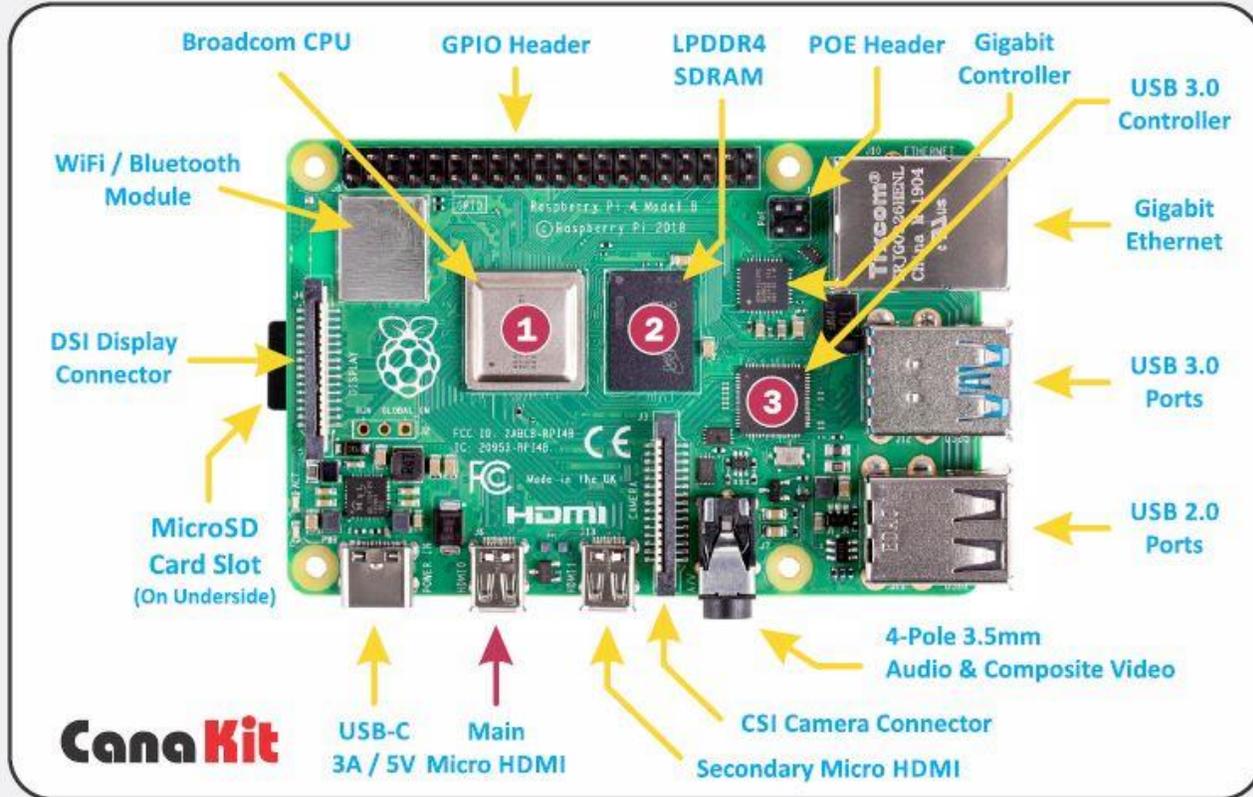


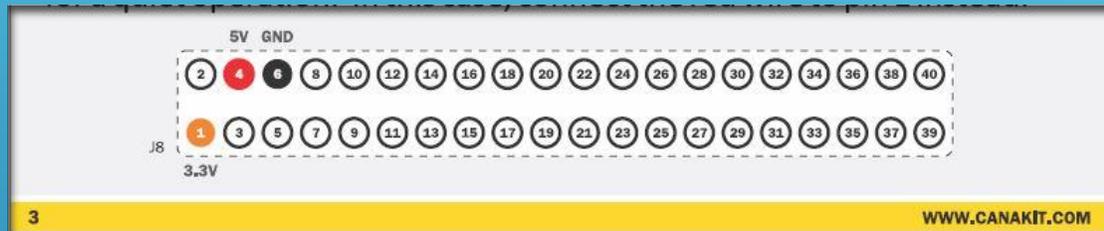
- ▶ 1.5GHz, 64-bit quad core ARM Cortex A-72 Processor
- ▶ 802.11ac Wi-Fi
- ▶ Bluetooth 5
- ▶ Full gigabit Ethernet
- ▶ USB 2.0 (2 ports)
- ▶ USB 3.0 (2 ports)
- ▶ HDMI HD Dual Monitor Support – 4K Resolution
- ▶ USB-C Power Connector

DESCRIPTION

BOARD LAYOUT

- ▶ Used by Permission
- ▶ WWW.CANAKIT.COM
- ▶ Ref: Set-up guide for CanaKit R-Pi 4 Board Kits – pg.3



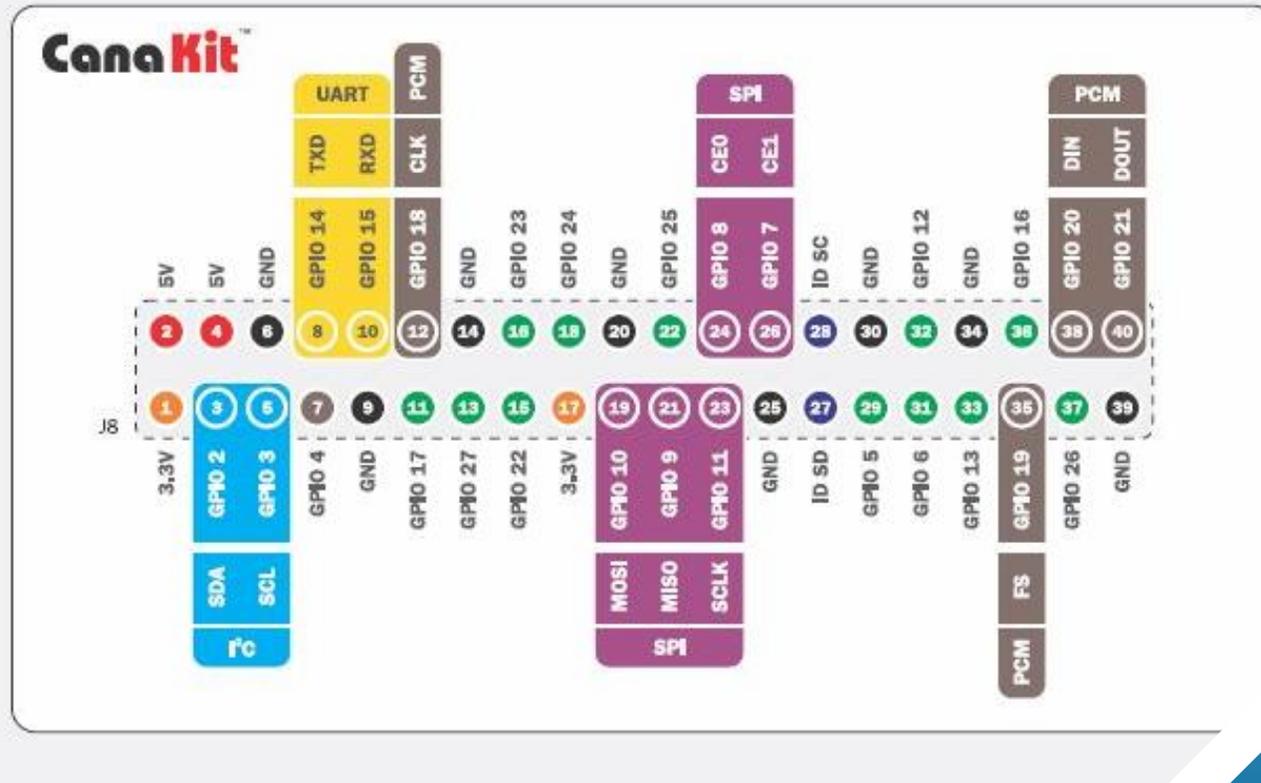


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GPIO HEADER

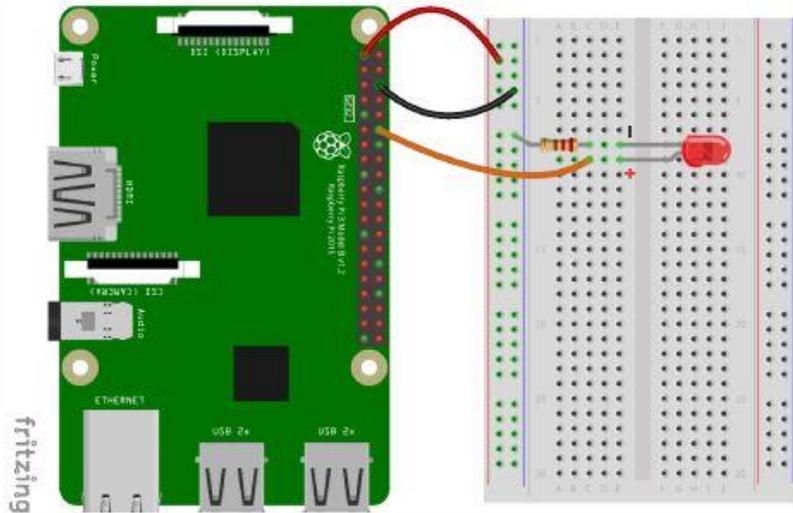
GPIO REFERENCE

Use the guide below to easily identify each of the 40-pins of the GPIO port.



GPIO PINOUT

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- ▶ WWW.CANAKIT.COM
- ▶ Ref: Set-up guide for CanaKit R-Pi 4 Board Kits – pg.11



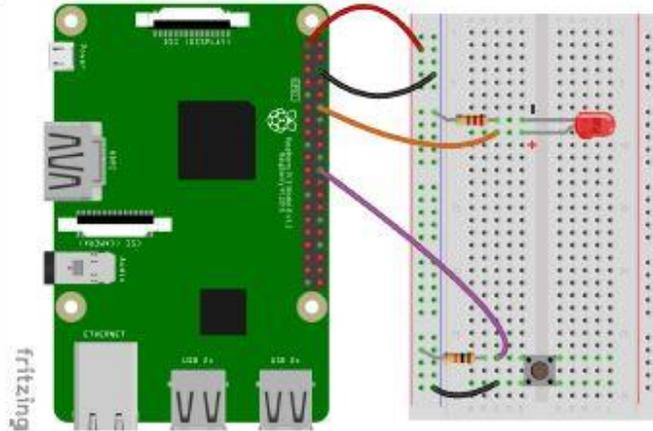
```
import RPi.GPIO as GPIO
import time
```

```
GPIO.setwarnings(False)
GPIO.setmode(GPIO.BCM)
GPIO.setup(18, GPIO.OUT)
```

```
while True:
    GPIO.output(18, True)
    time.sleep(1)
    GPIO.output(18, False)
    time.sleep(1)
```

- ▶ Used by Permission
- ▶ WWW.CANAKIT.COM
- ▶ Ref: Set-up guide for CanaKit R-Pi 4 Board Kits – pg.9

BLINK LED



```
import RPi.GPIO as GPIO
import time

GPIO.setwarnings(False)
GPIO.setmode(GPIO.BCM)
GPIO.setup(18, GPIO.OUT)
GPIO.setup(25, GPIO.IN)

while True:
    if GPIO.input(25):
        GPIO.output(18, False)
    else:
        GPIO.output(18, True)
```

WWW.CANAKIT.COM

- ▶ Used by Permission
- ▶ WWW.CANAKIT.COM
- ▶ Ref: Set-up guide for CanaKit R-Pi 4 Board Kits – pg.10

LED WITH BUTTON CONTROL

Exploring Raspberry Pi is THE book to go to if you are interested in learning about the impressive physical computing capabilities of the Raspberry Pi platform. Derek Molloy imparts the electronics, programming, and embedded Linux skills that are vital to today's innovators in building the next generation of Internet of Things applications.*

—Eben Upton, Co-creator of the Raspberry Pi

DEREK MOLLOY

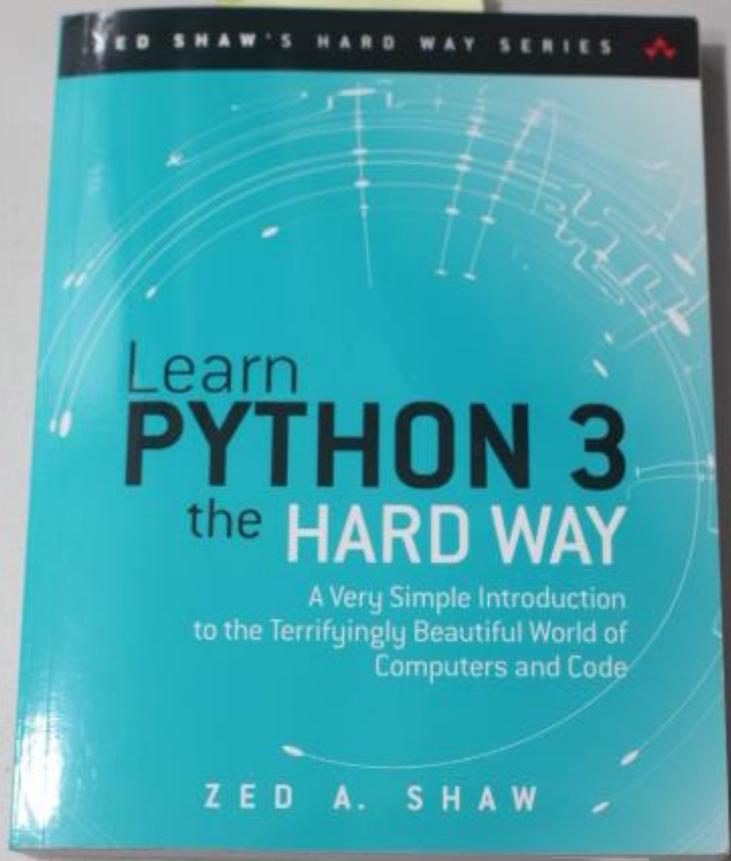
EXPLORING
RASPBERRY PI

INTERFACING TO THE REAL WORLD WITH EMBEDDED LINUX*



WILEY

IN-DEPTH
REFERENCE GUIDES
AVAILABLE



SAME FOR
PROGRAMMING
AND SUCH

WHAT IS
NEEDED



Roll over image to zoom in

- ▶ Raspberry Pi 4 Computer (8 GB preferred)
- ▶ Case
- ▶ Cooling Fan
- ▶ Heat Sinks
- ▶ Power Supply / Cable
- ▶ HDMI Video Cable (for the display)
- ▶ 32GB EVO+ Micro SD Card (with NOOBS)
- ▶ Card Reader Adapter
- ▶ Spare Cards (optional)
- ▶ Means to label and store unused cards

R-PI ESSENTIALS



- ▶ **HD 16:9 Display (HDMI Input)**
- ▶ **Keyboard (USB)**
- ▶ **Mouse (USB)**
- ▶ **Internet Availability**
- ▶ **Network Cable**

R-PI ESSENTIALS



- ▶ HDMI Video (A-B) Switch
- ▶ Allows user to share a single Display between two Computing Devices
- ▶ (a PC and a Raspberry Pi, for example)

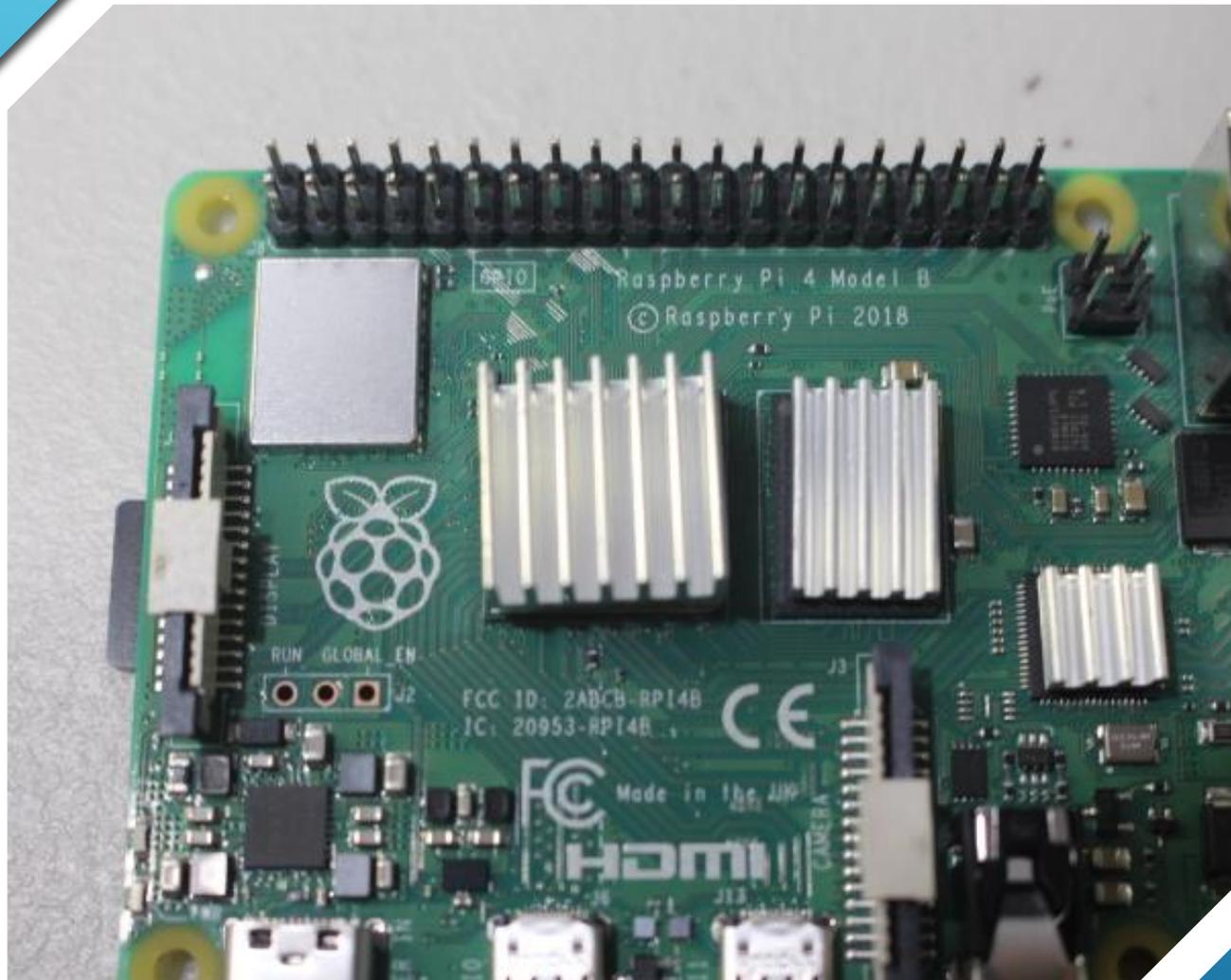
OPTIONAL



- ▶ SD/Micro SD Card Reader Combo (USB3)
- ▶ Micro SD to SD Card Adapter (with write protect lock)
- ▶ Install Free SD Card Format Software (to pc)
- ▶ Install Free SD Card Imaging Software (to pc)

HIGHLY RECOMMENDED

GETTING
STARTED



ASSEMBLY

- ▶ **Attach Heat Sinks (3)**
- ▶ Secure Pi to Base Plate
- ▶ Attach Case Wall Assy
- ▶ Attach/Connect Cooling Fan
- ▶ Attach Case Lid



ASSEMBLY

- ▶ Attach Heat Sinks
- ▶ **Secure Pi to Base Plate** (SD Card Removed)
- ▶ Attach Case Wall Assy
- ▶ Attach/Connect Cooling Fan
- ▶ Attach Case Lid



ASSEMBLY

- ▶ Attach Heat Sinks
- ▶ Secure Pi to Base Plate
- ▶ **Attach Case Wall Assy**
- ▶ Attach/Connect Cooling Fan
- ▶ Attach Case Lid



ASSEMBLY

- ▶ Attach Heat Sinks
- ▶ Secure Pi to Base Plate
- ▶ Attach Case Wall Assy
- ▶ **Attach/Connect Cooling Fan**
- ▶ Attach Case Lid

ASSEMBLY

- ▶ Attach Heat Sinks
- ▶ Secure Pi to Base Plate
- ▶ Attach Case Wall Assy
- ▶ Attach/Connect Cooling Fan
- ▶ **Attach Case Lid**



SIDE VIEW

- ▶ USB-C (PWR In)
- ▶ HDMI Out (Port 0)
- ▶ HDMI Out (Port 1)
- ▶ Audio Out (Stereo)





FWD END VIEW

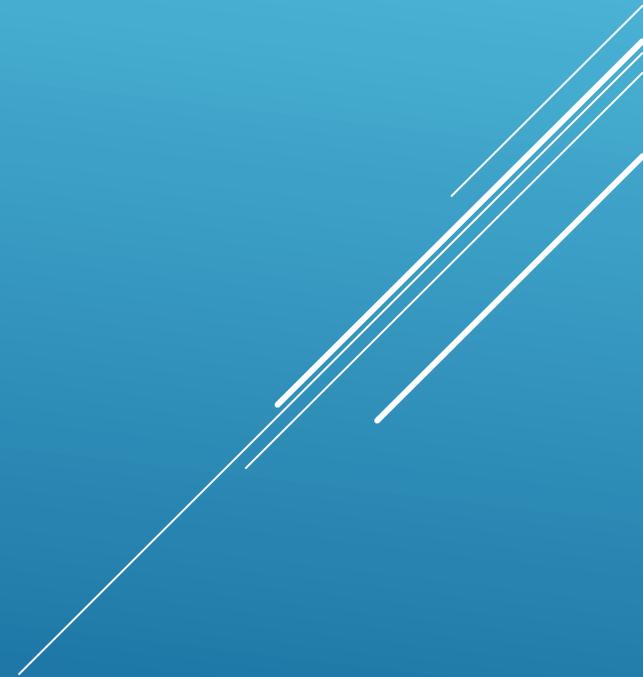
- ▶ Keyboard (UL) - USB
- ▶ Mouse (UR) - USB
- ▶ USB Port
- ▶ USB Port
- ▶ Network Cable Port



AFT END VIEW

- ▶ Micro SD Card Slot (O/S)
- ▶ Insert AFTER case fully assembled
- ▶ (When ready to load or use software)

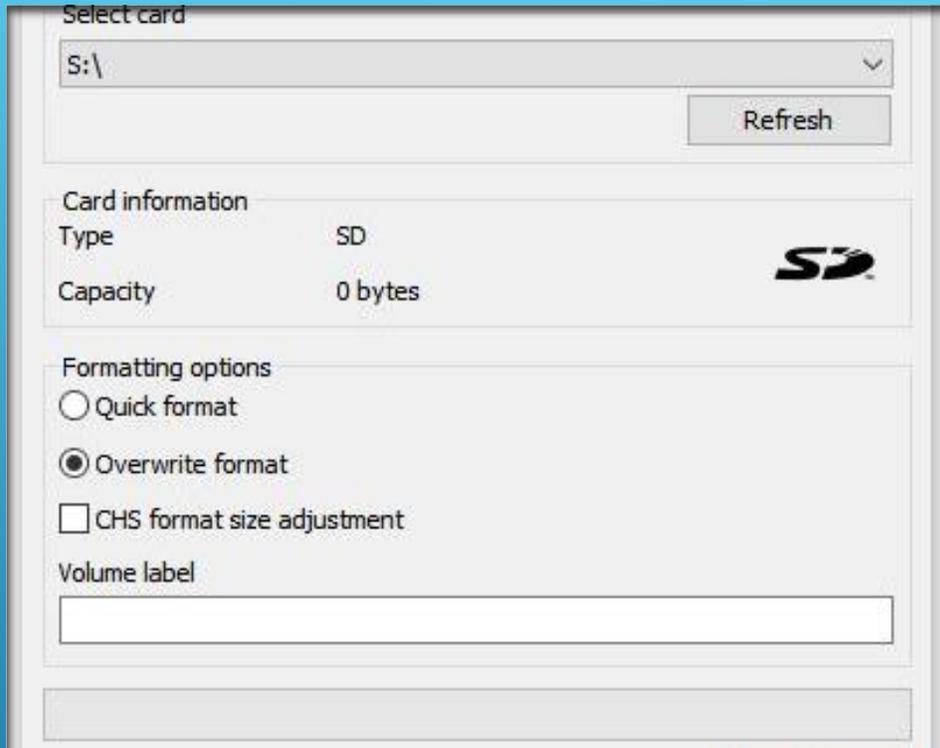
RECOMMENDED (BEST) PRACTICES





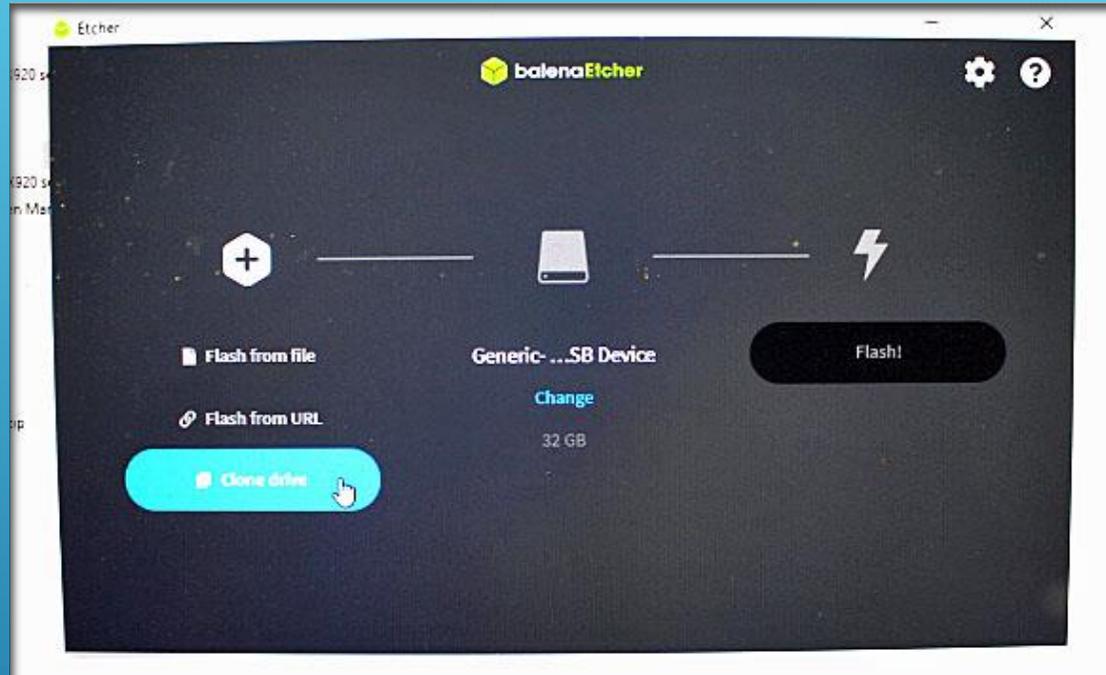
INSTALL PC TOOLS

- ▶ <https://www.sdcard.org/>
- ▶ Download / Install “SD Memory Card Formatter for Windows”
- ▶ <https://sourceforge.net/projects/etcher.mirror/>
- ▶ Download / Install “Etcher”



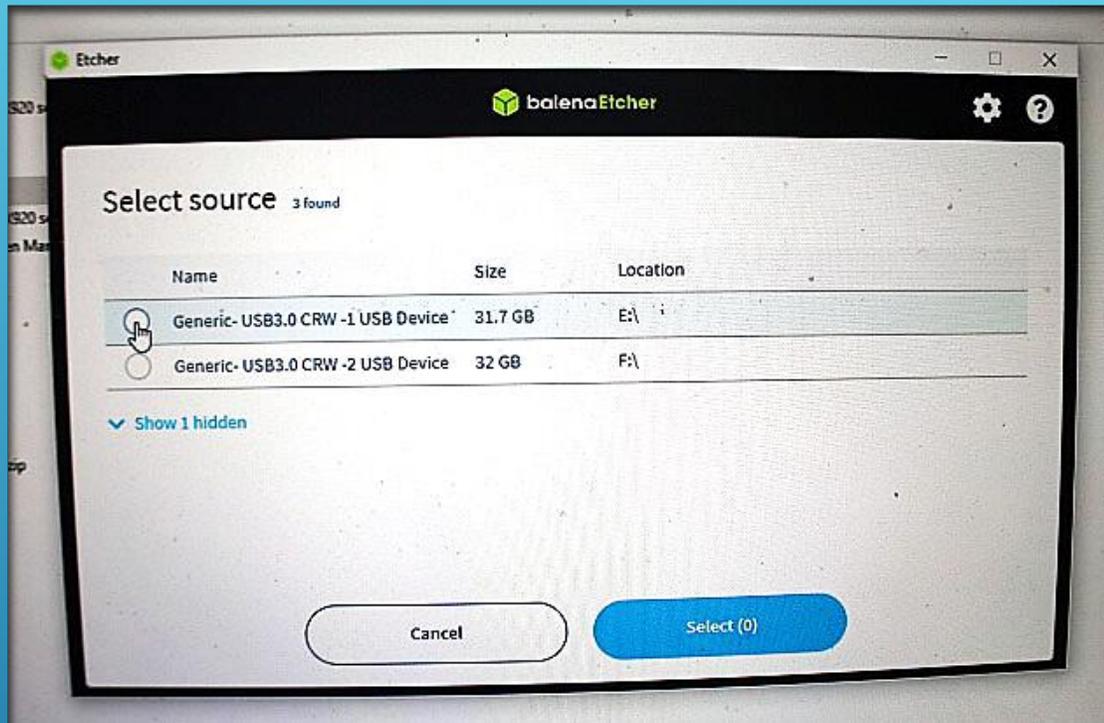
- ▶ Be sure to select the card you INTEND to format. Everything will be erased! There is no forgiveness!
- ▶ You can use “Quick Format” to format blank (new) cards.
- ▶ Use “Overwrite Format” to format cards that already contain data or previously partitioned for Raspberry Pi use.
- ▶ You can add a “Volume label” (name) if desired.
- ▶ Click “Refresh” to start formatting process

SD FORMATTER NOTES:



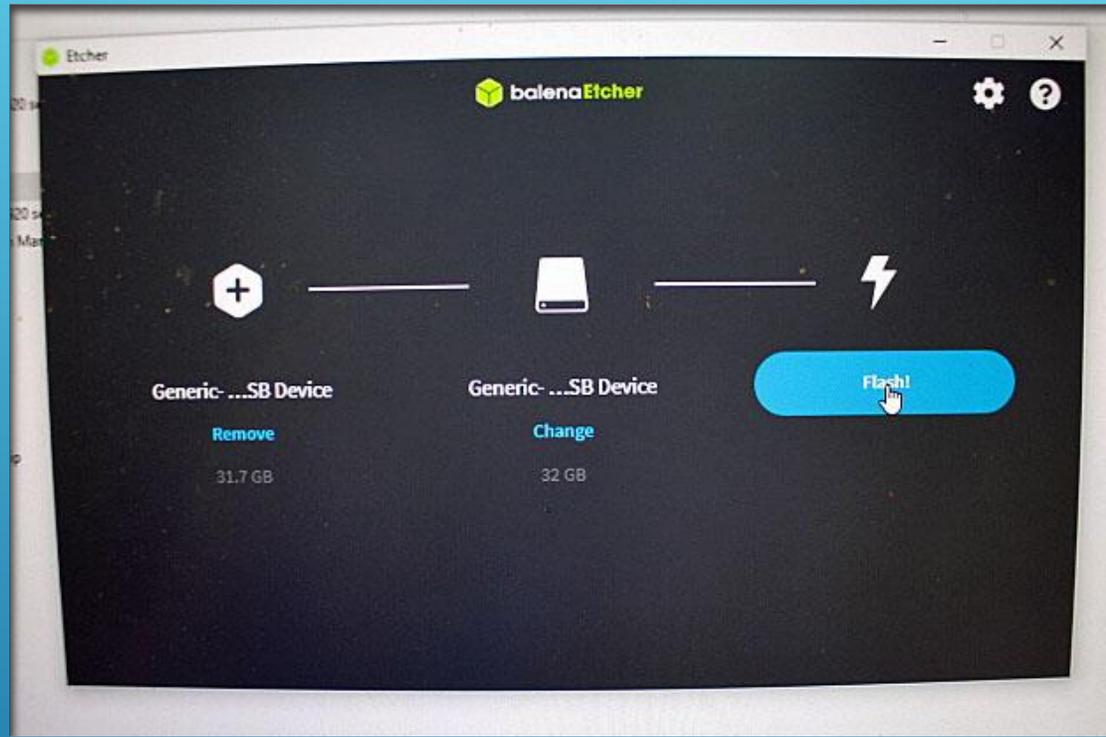
- ▶ When copying an SD Card (Source) to another one (Target) select “CLONE” from the list. This makes the Target card into an “image” of the Source “Master” card.
- ▶ Ensure the Source SD Card is “Write Protected” by placing it in a Micro SD Adapter having the mechanical “Lock” Switch in the LOCK position.

ETCHER NOTES:



- ▶ Be sure to indicate which Location has the “Source” device in place (the one that is in the write protected adapter).
- ▶ The other one (by default) will become the “Target”.
- ▶ Click the “Select” button to continue.

ETCHER NOTES:



- ▶ Clicking the “Flash” button starts the cloning process.
- ▶ To avoid corrupting either SD Card during removal, be sure to “eject” the devices properly before unplugging the cards.

ETCHER NOTES:

BACKING UP NOOBS

- ▶ Plug card reader into Laptop or PC
- ▶ Using SD Formatter, **FORMAT** a blank micro-SD card
- ▶ Insert NOOBS card into “locked” SD Card Adapter
- ▶ Use “ETCHER” to copy “NOOBS” Card Image to previously formatted card.
- ▶ Store the “MASTER” NOOBS card in a safe place.
- ▶ Work from the NOOBS “BACKUP” card, going forward.



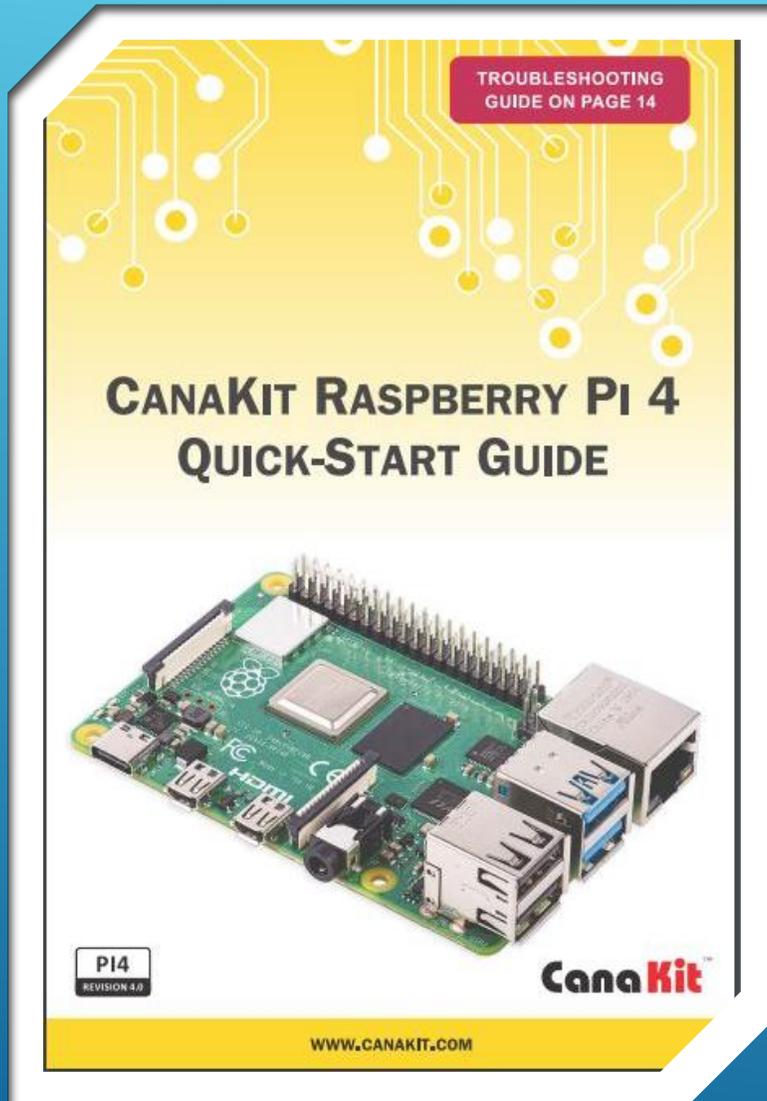
ADD'L. BACKUPS

- ▶ Using the same process in the previous slide:
- ▶ Always have a handy backup copy of any SD Cards you want to preserve.
- ▶ If a card is corrupted for any reason,
- ▶ you can replace the defective card, power up and keep going!
- ▶ Don't forget to make a NEW backup card derived from the spare.



HERE WE GO!





- ▶ Used by Permission
- ▶ WWW.CANAKIT.COM
- ▶ Set-up guide for CanaKit R-Pi 4 Board Kits

CANAKIT RPI-4 QUICK-START GUIDE



- ▶ Refer to “Quick-Start Guide”
- ▶ HD 16:9 Display (connect to HDMI-0 port on Pi 4)
- ▶ Turn monitor “ON” and select proper input (HDMI).
- ▶ Keyboard (Connect to a Pi 4 USB port)
- ▶ Mouse (Connect to a Pi 4 USB port)
- ▶ Ensure Internet Available
- ▶ Connect Network Cable to Pi 4 Ethernet port (optional)

ASSEMBLE SYSTEM COMPONENTS

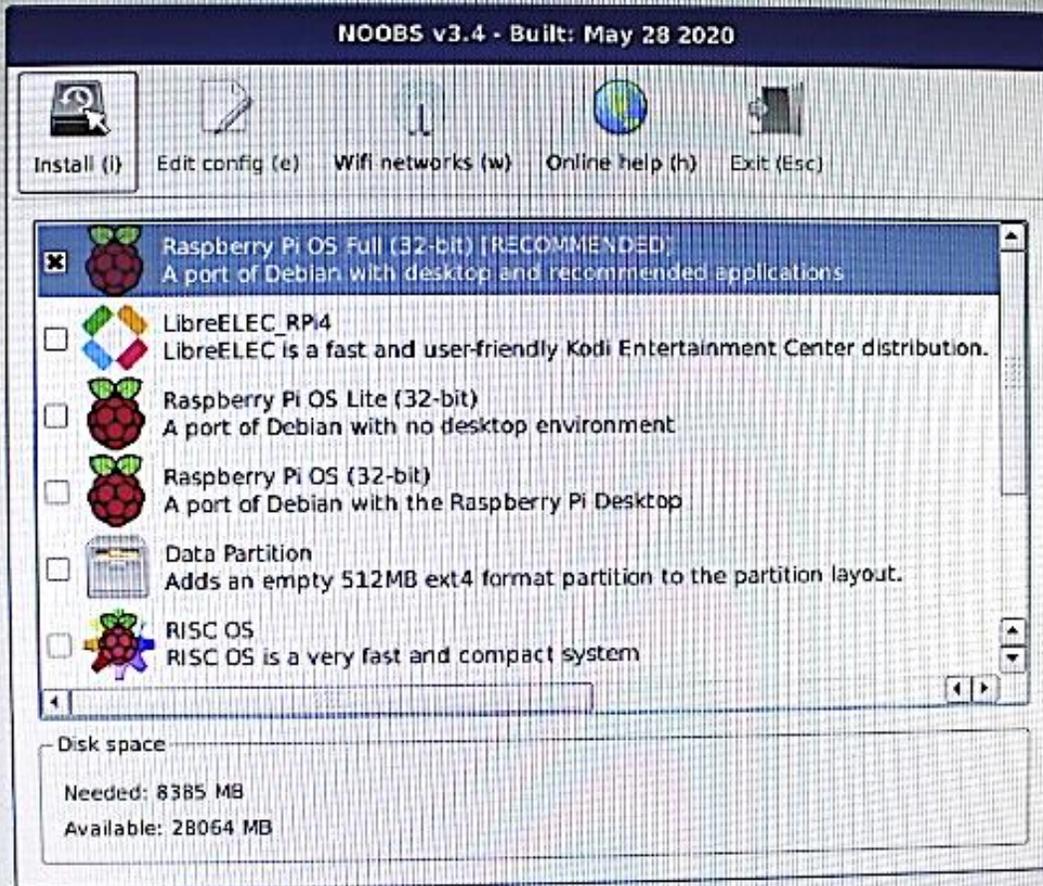


INSTALL O/S SOFTWARE

- ▶ Refer to “Quick-Start Guide”
- ▶ Pi 4 DC Power Disconnected (OFF)
- ▶ Insert NOOBS card into MicroSD slot
- ▶ Pi 4 DC Power Connected (ON)
- ▶ Raspberry Pi will start to boot
- ▶ Follow Instructions and Screen Prompts

INSTALL O/S SOFTWARE

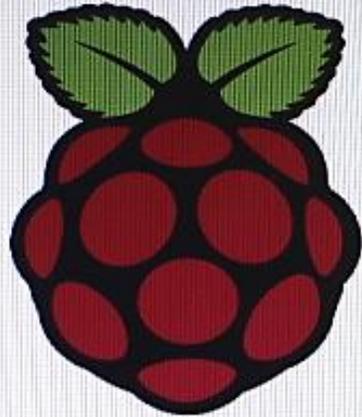
- ▶ Select the “Recommended” O/S with desktop AND applications
- ▶ Click the “Install” Button
- ▶ Selected O/S will start to load.



INSTALL O/S SOFTWARE

- ▶ **Be patient**
- ▶ **Installation takes several minutes**

Welcome to Raspberry Pi



Please wait while the software is installed on your SD card – this will take a few minutes.

Raspberry Pi OS Full (32-bit): Downloading and extracting filesystem



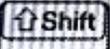
24%

1566 MB of 6503 MB written (10.7 MB/sec)

INSTALL O/S SOFTWARE

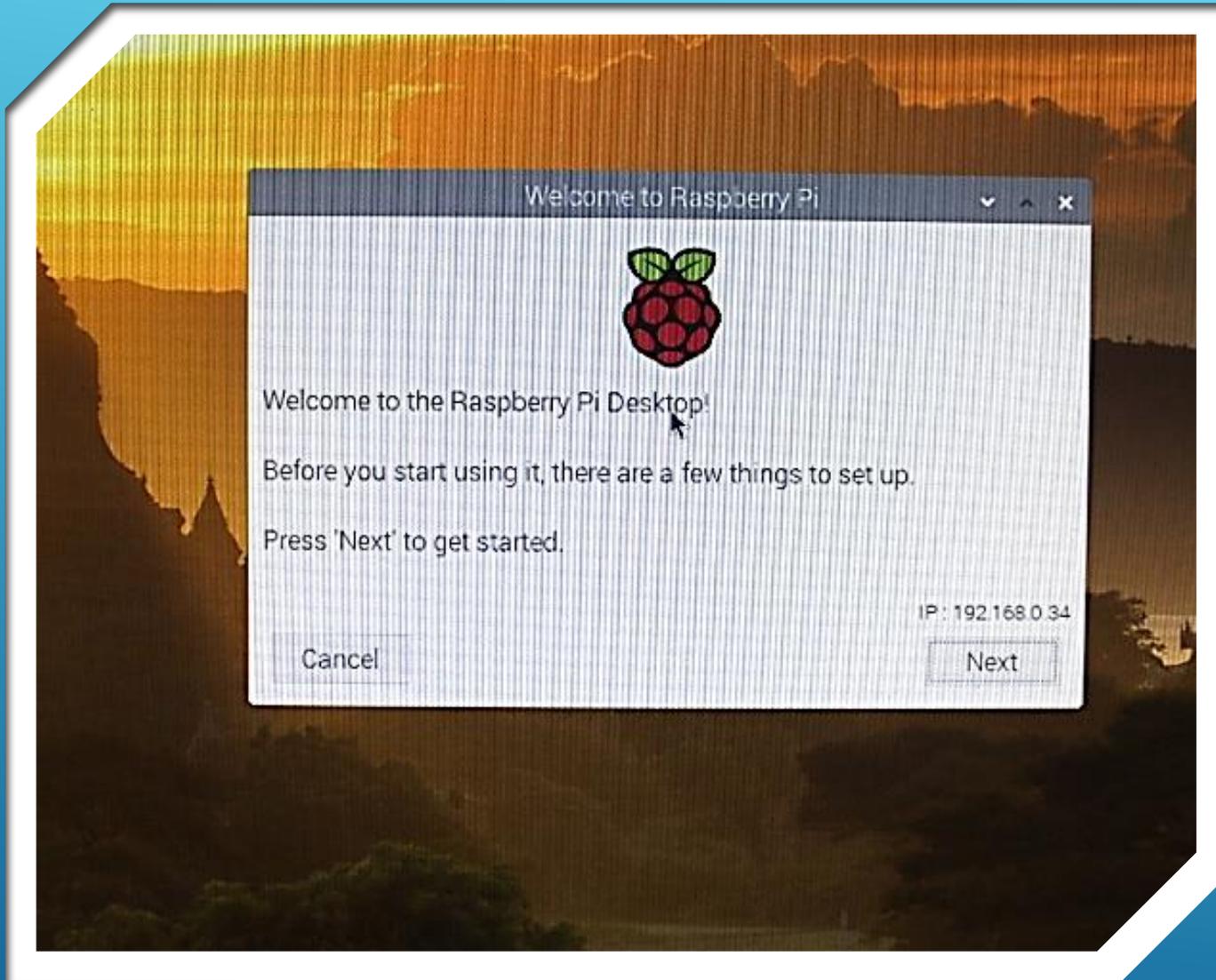
- ▶ Voila!...
- ▶ But wait... There's More!



For recovery mode, hold  Shift

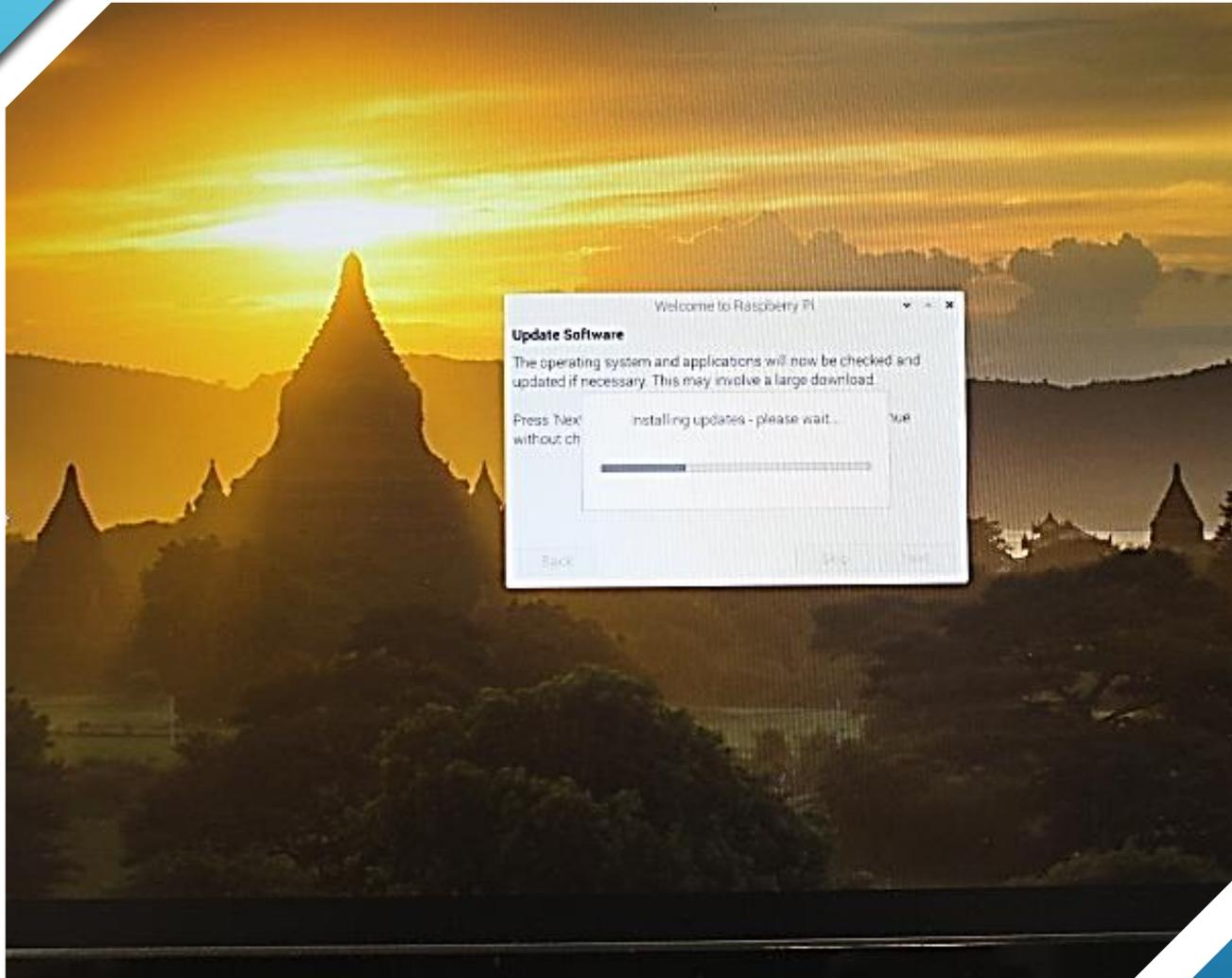
INSTALL O/S SOFTWARE

- ▶ Keep following the prompts!
- ▶ You'll set up language, location, time zone and other preferences.
- ▶ And, your wi-fi settings.



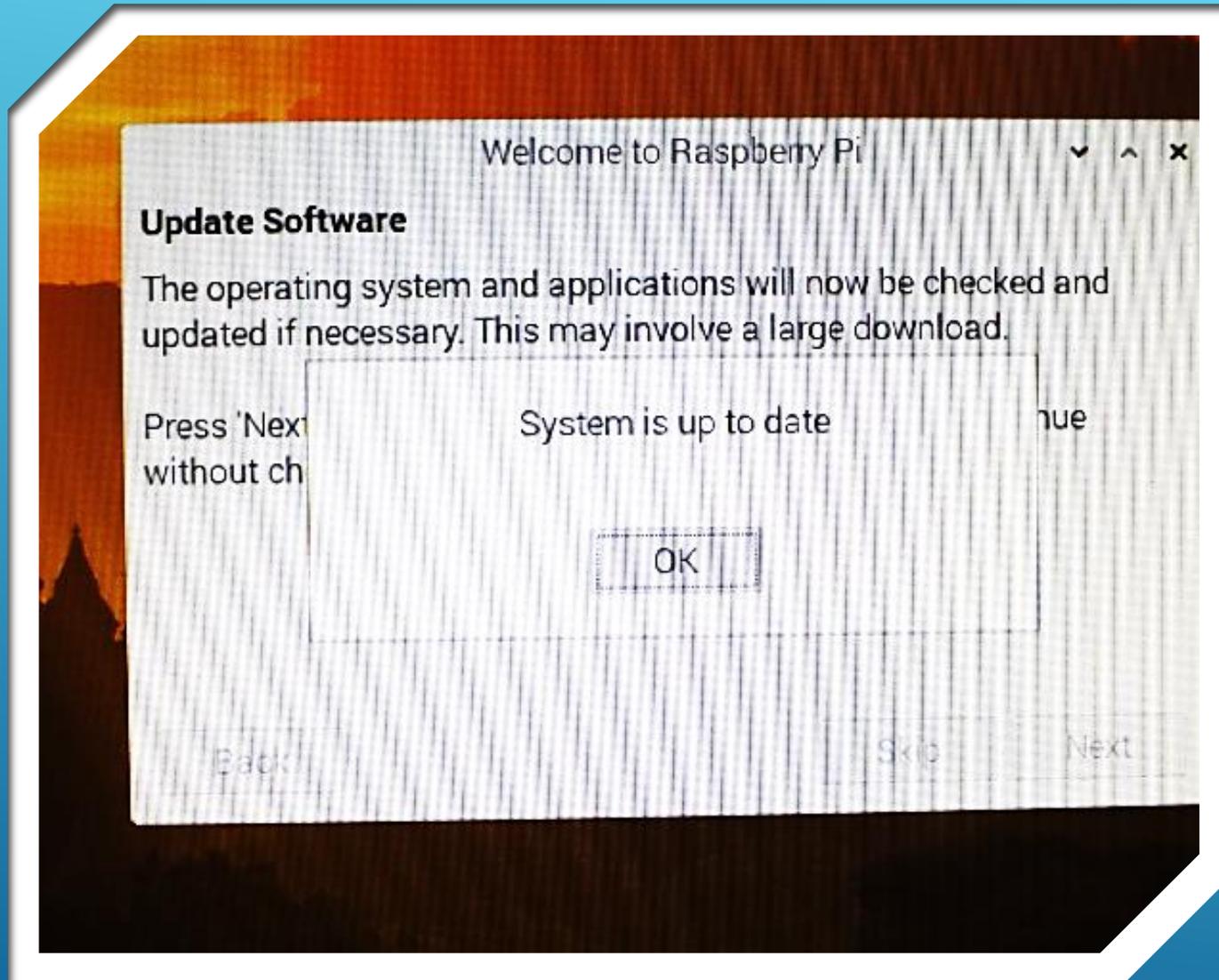
INSTALL O/S SOFTWARE

- ▶ **Almost done!**
- ▶ **You've been a real trooper!!**
- ▶ **Hang in there a little more!!!**



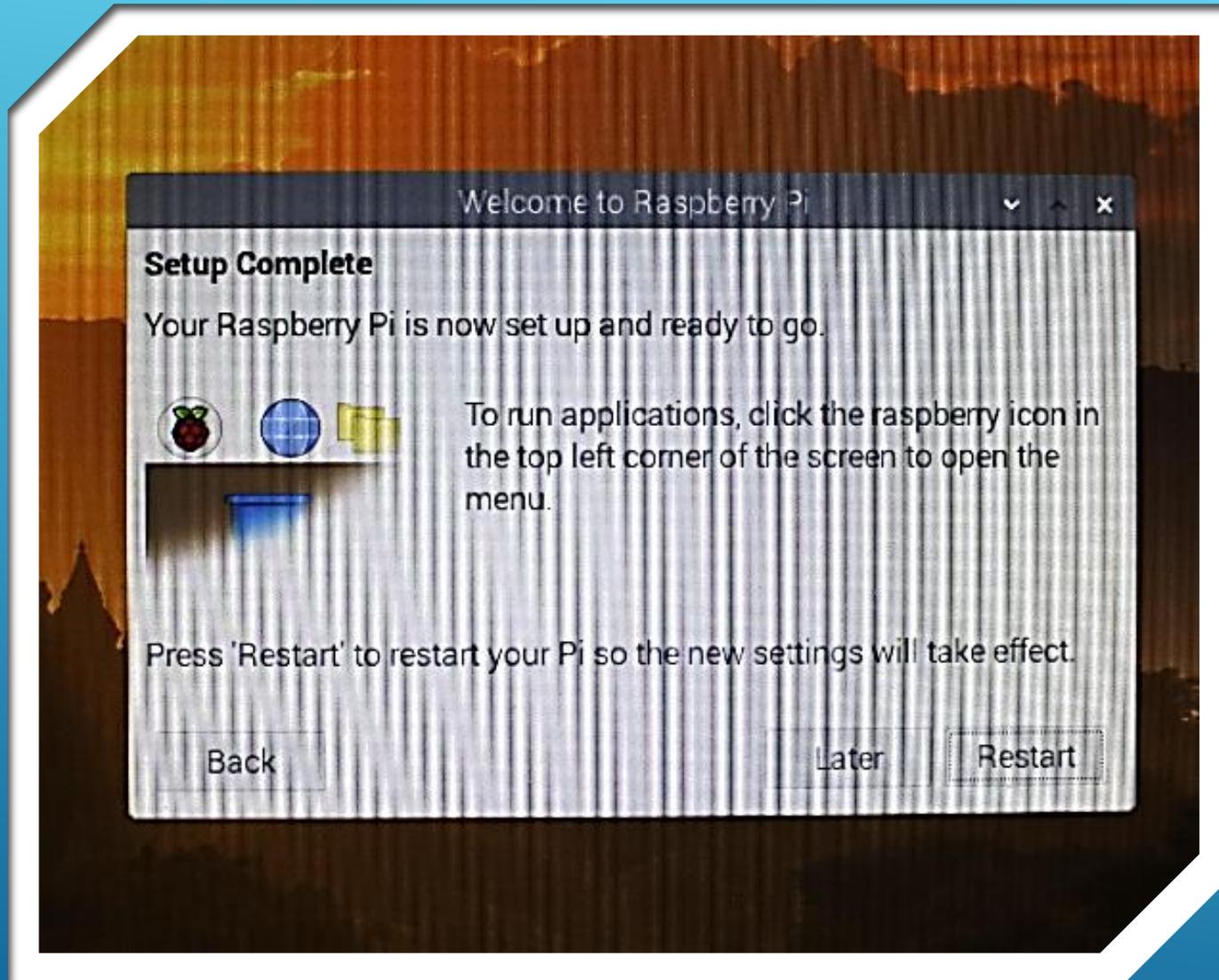
INSTALL O/S SOFTWARE

- ▶ YOU DID IT !!!
- ▶ Congratulations!



INSTALL O/S SOFTWARE

- ▶ Click “Restart” to activate settings!

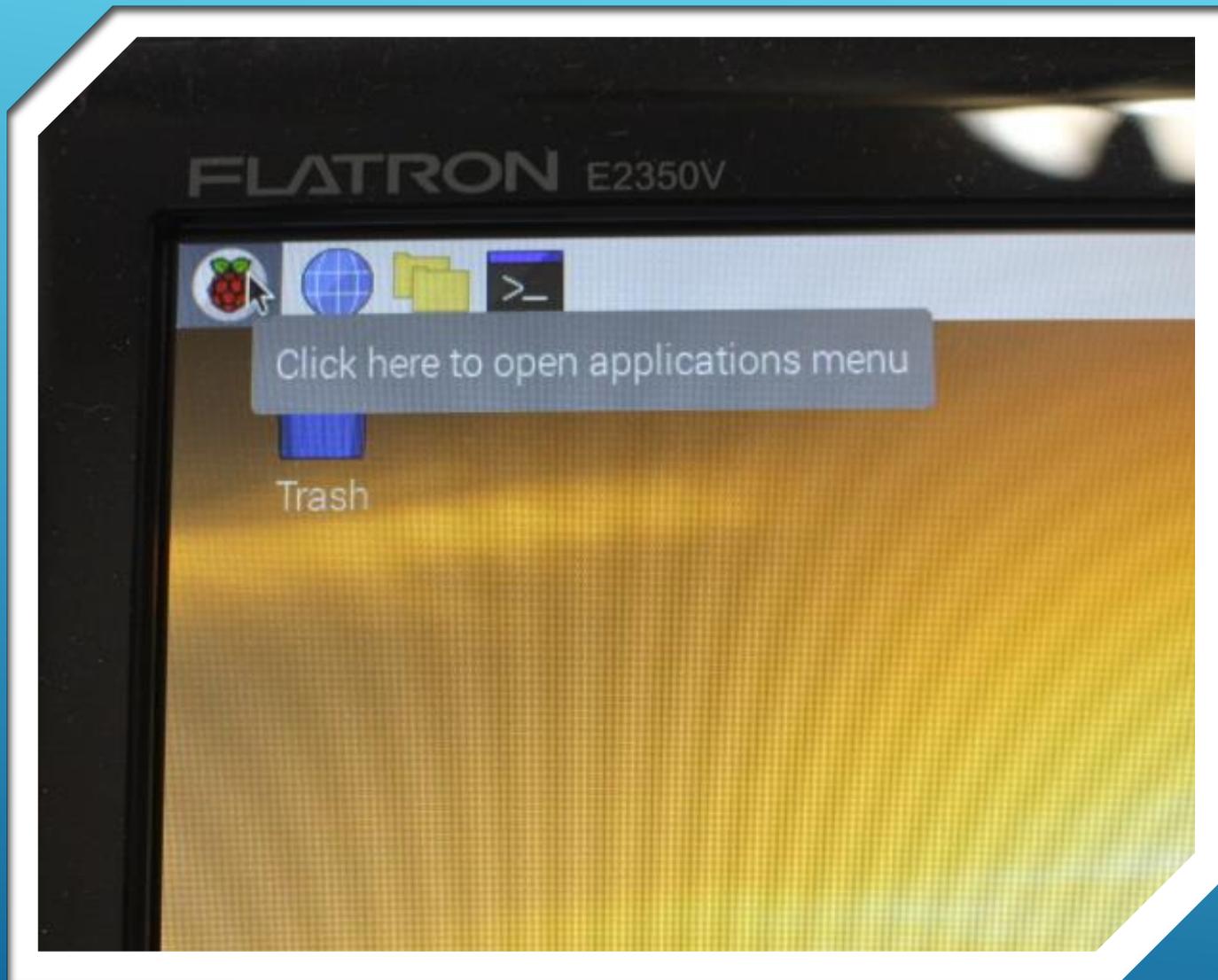




DESKTOP GUI

Ready to go!!!

Let's explore...

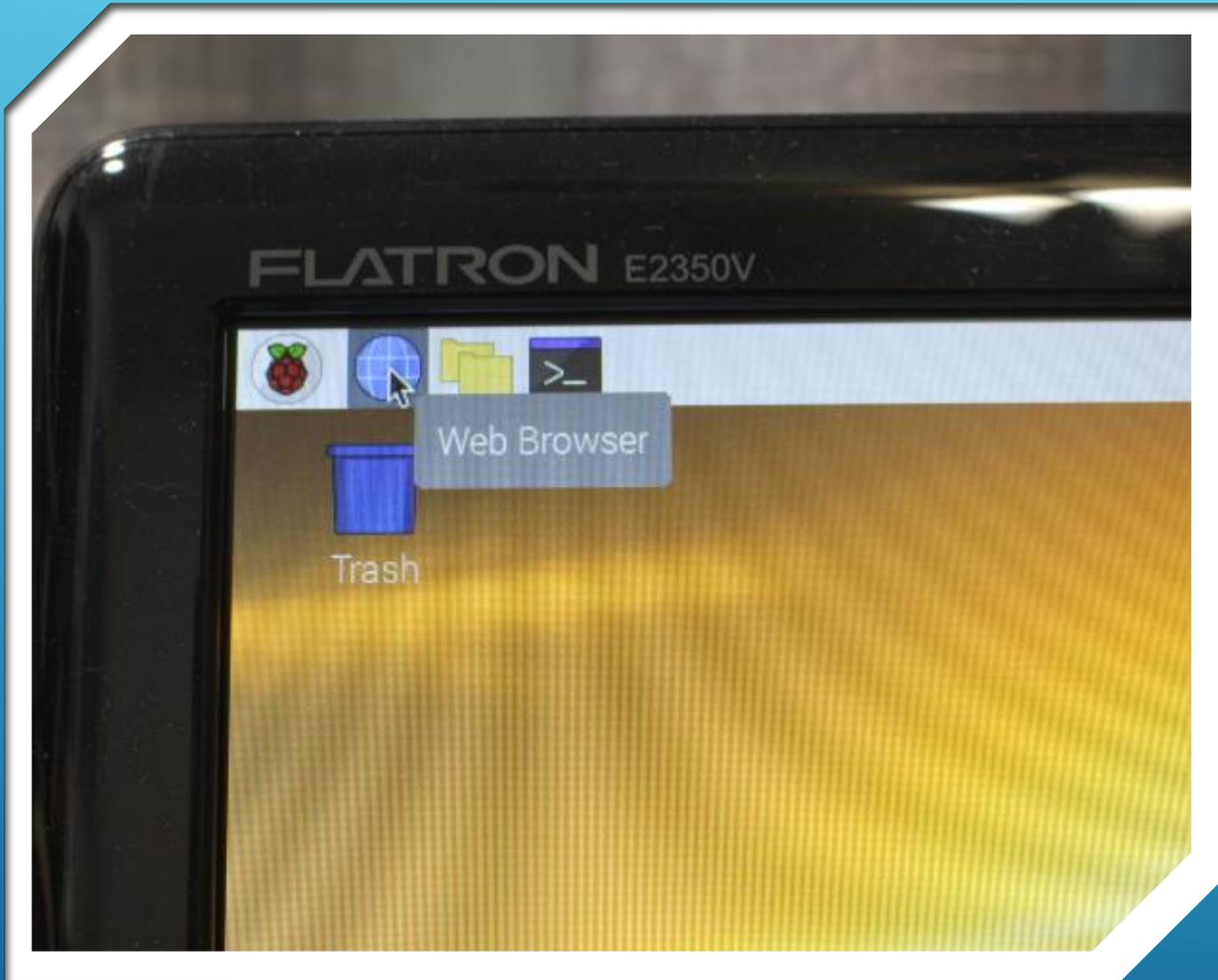


DESKTOP GUI

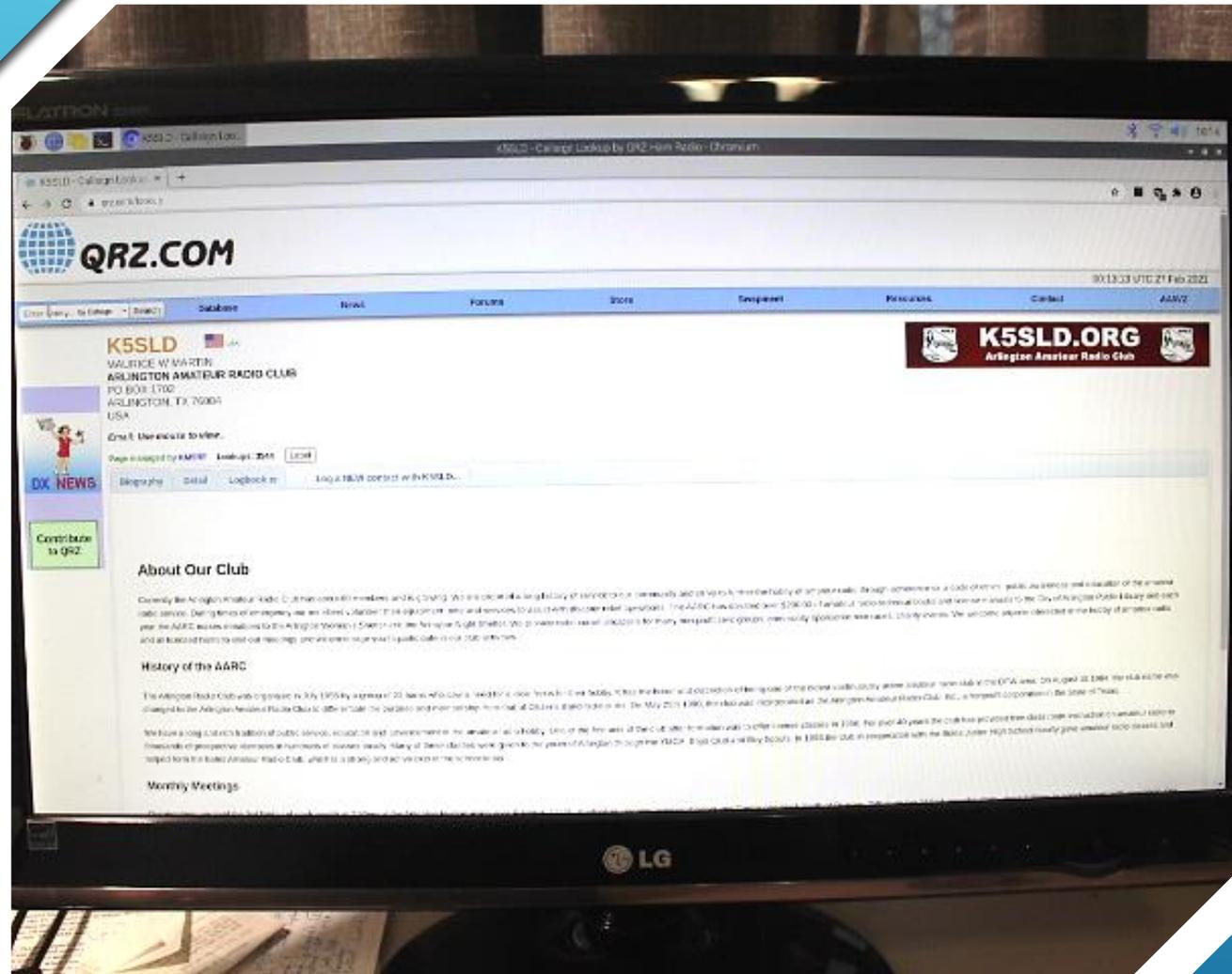
FLATRON E2350V



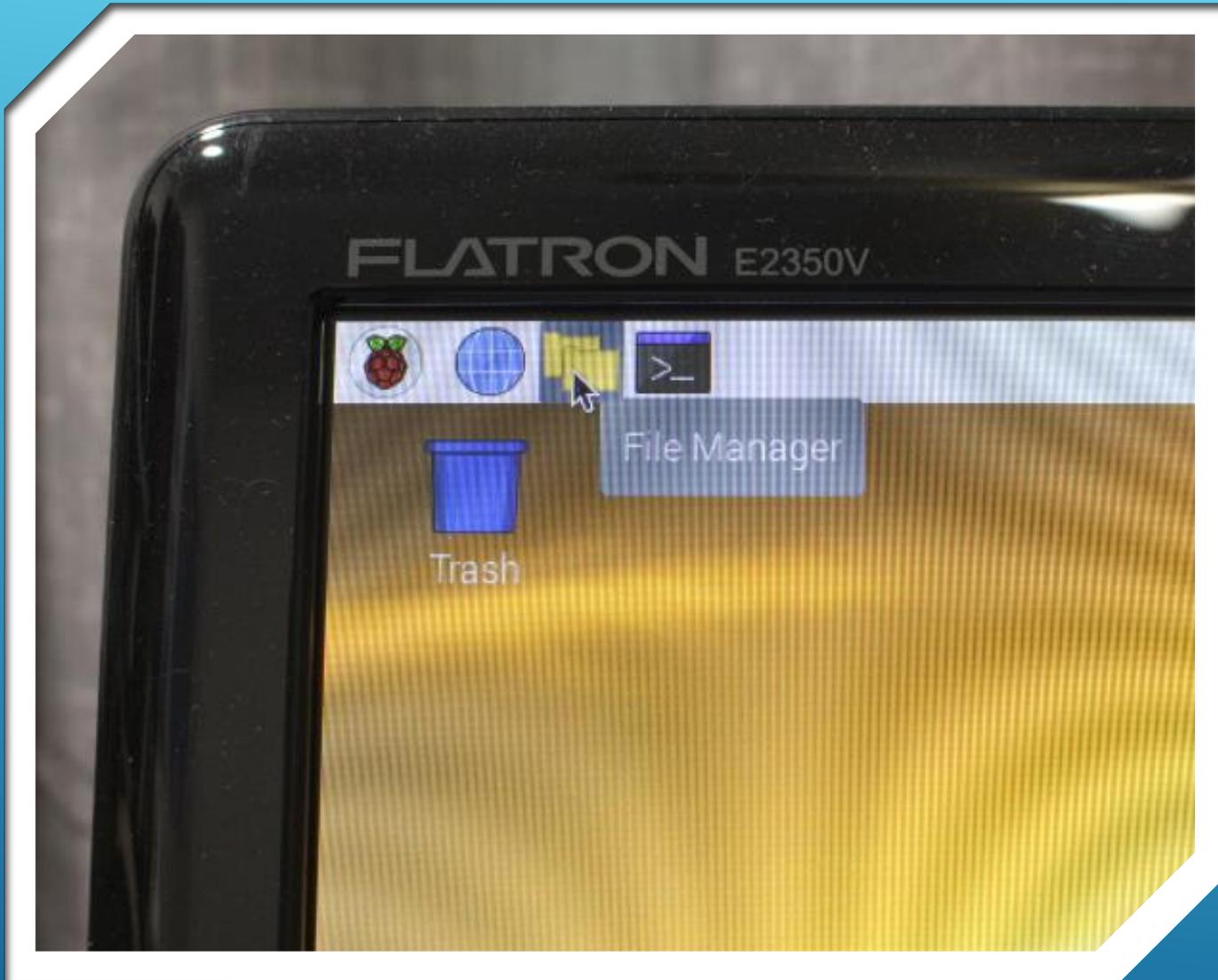
DESKTOP GUI



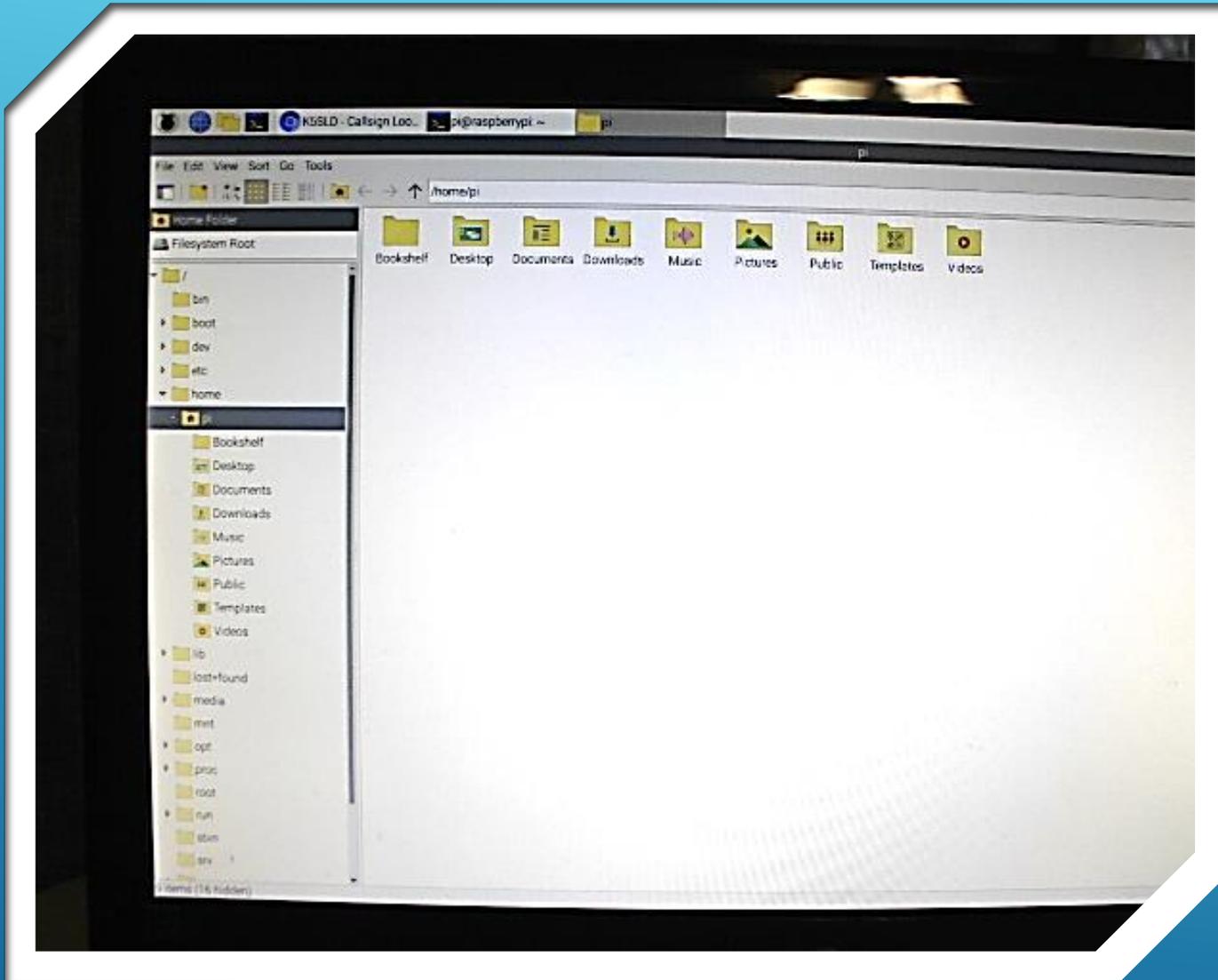
DESKTOP GUI



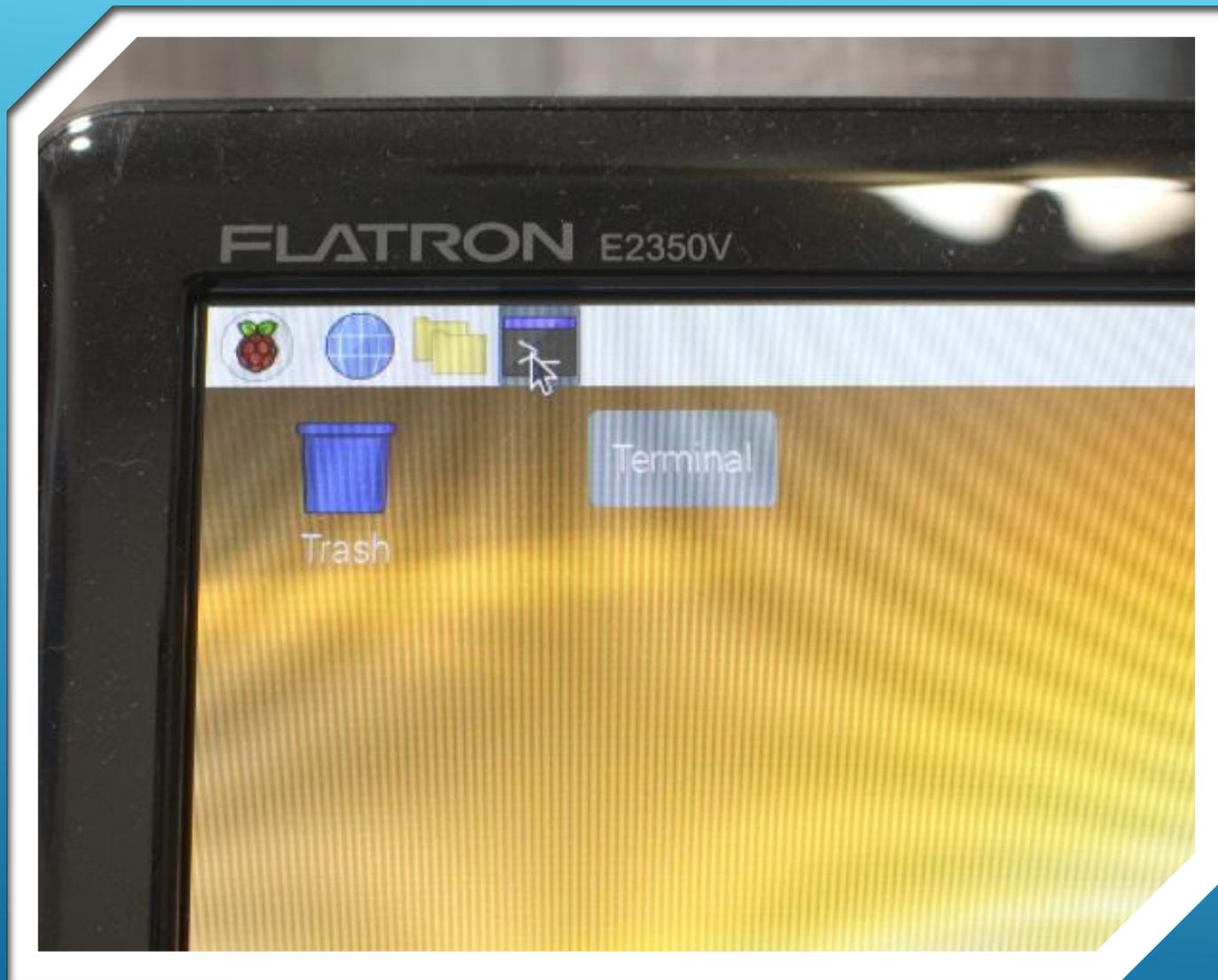
DESKTOP GUI



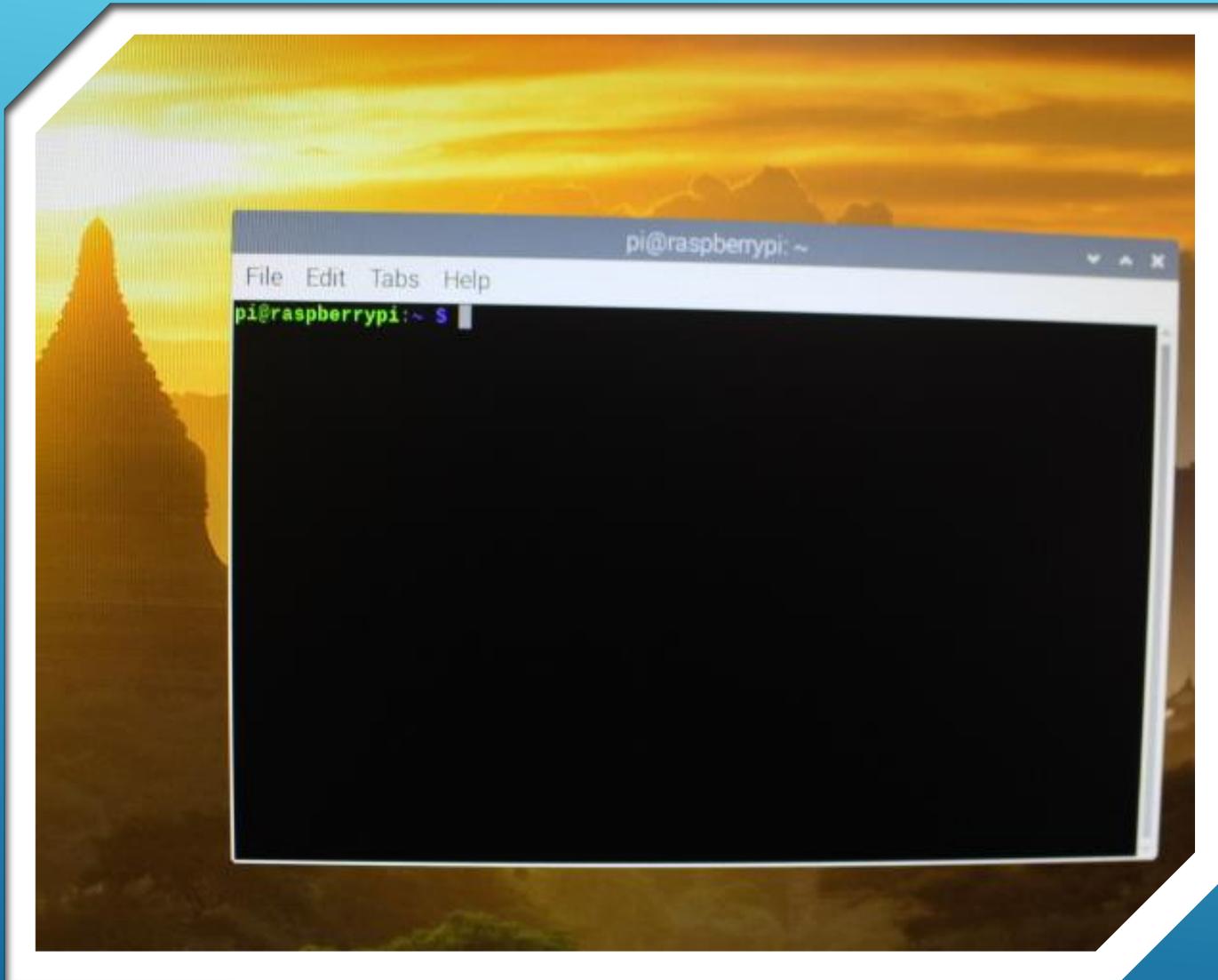
DESKTOP GUI



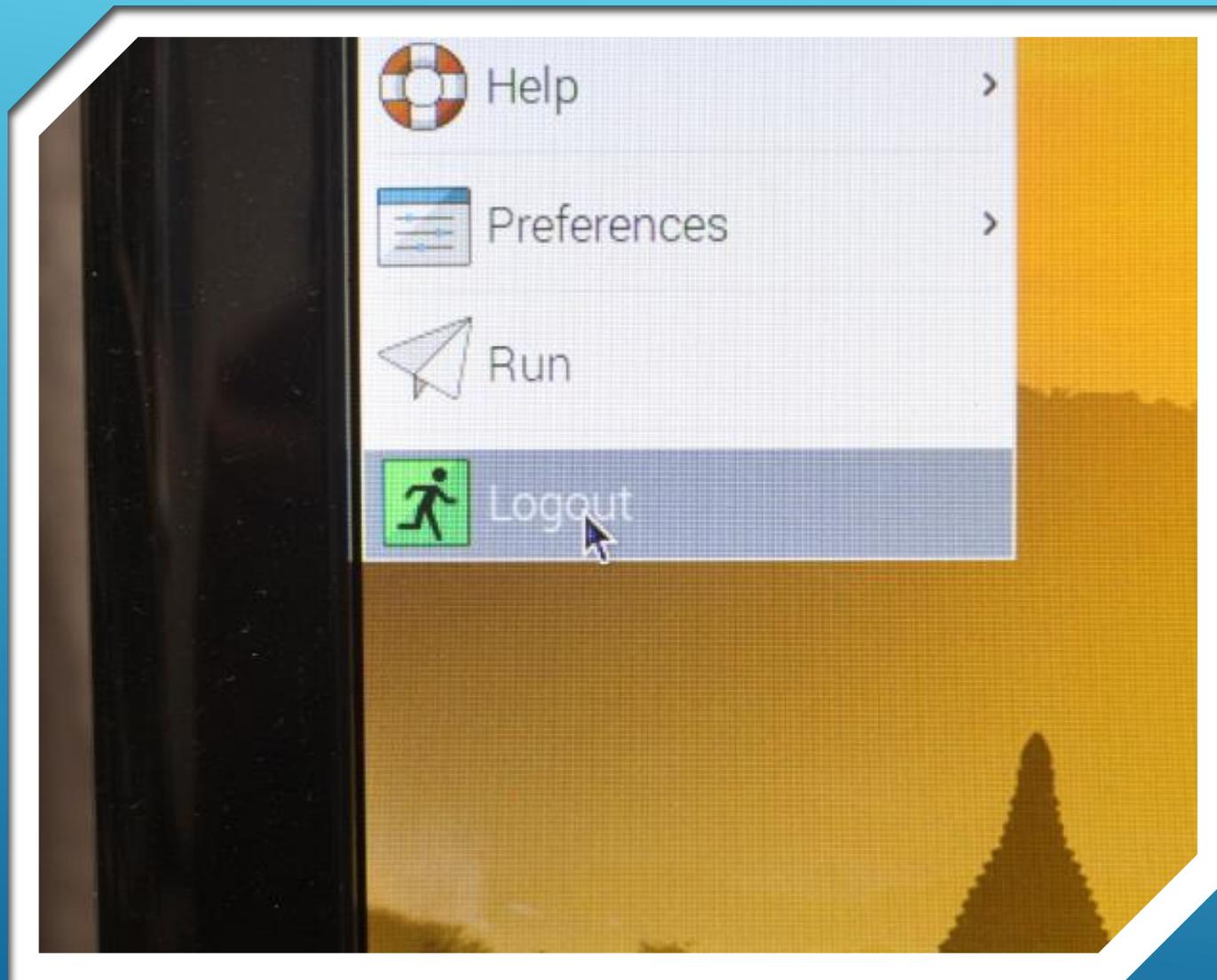
DESKTOP GUI



DESKTOP GUI



DESKTOP GUI

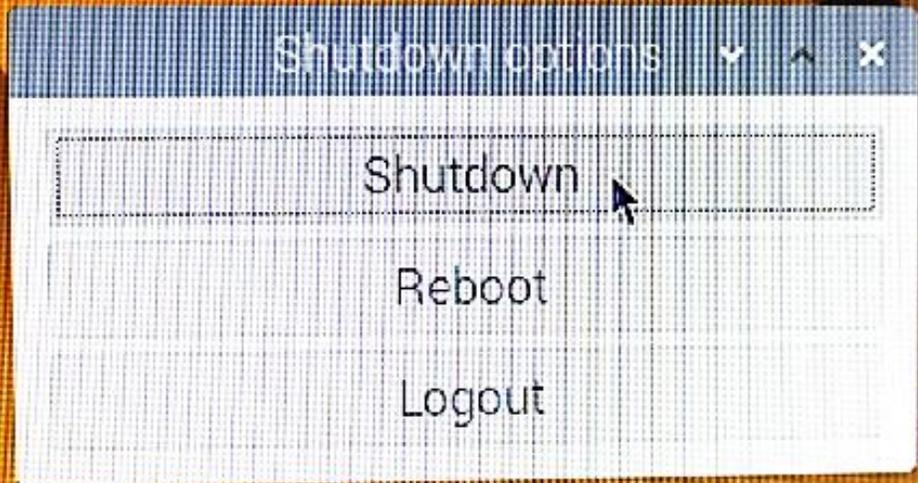


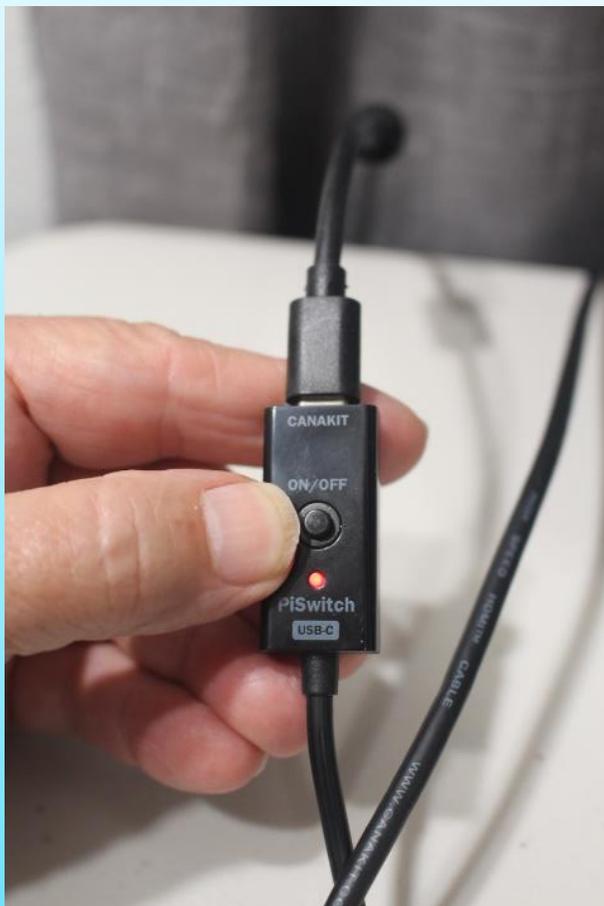
SHUTDOWN SEQUENCE – STEP 1

- ▶ Always follow this sequence for shutdown!
- ▶ Avoids SD Card Corruption
- ▶ And Bitter Tears!!!!
- ▶ Most important...
- ▶ Always make and store a copy of the current SD Card in use.
- ▶ If your card gets corrupted, you don't have to start over...FROM SCRATCH!

SHUTDOWN SEQUENCE – STEP 2

- ▶ Always follow this sequence for shutdown!
- ▶ Avoids SD Card Corruption
- ▶ And Bitter Tears!!!!
- ▶ Most important...
- ▶ Always make and store a copy of the current SD Card in use.
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SHUTDOWN SEQUENCE – STEP 3

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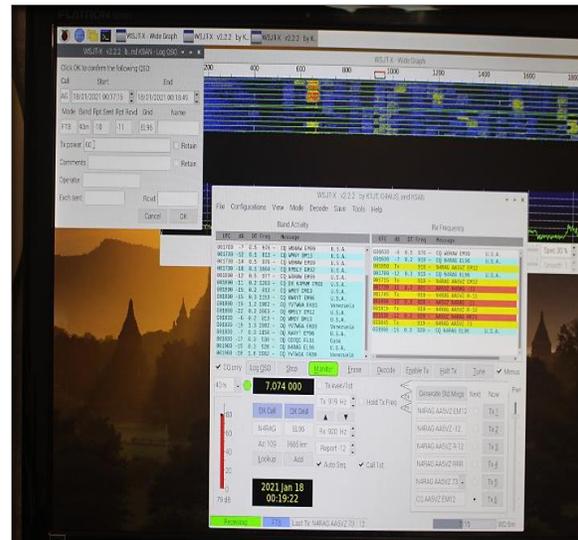


SHUTDOWN SEQUENCE

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- ▶ **Load the base Operating System (O/S)**
- ▶ **Install and Configure Ham Radio Apps**
- ▶ **Interface the Pi with your Station**
- ▶ **Get on the Air!**



Arlington Amateur Radio Club

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Presentations

Click any active link to view the Presentation for that month.

Presentations

- [Monthly Zoom Meeting](#) - passcode 9@sZF6=L
- [2021 - February - Getting Started with Solar Backup Power in the Shack](#)
- [2021 - January - Getting Started with FM Satellites](#)
- [June 2020 Field Day](#)
- [May 2020 Eavesdropping on the Moon Links](#)
- [April 2020 Filters](#)
- [January 2020 My Telephone Company Journey and a Little History](#)
- [January 2019 Using PSKReporter As A Propagation Tool](#)
- [May 2018 Introducing FT8!](#)
- [January 2018 Workbench on a Budget](#)

1. www.canakit.com
2. www.raspberrypi.org
3. www.arrl.org/qst
4. www.k5sld.com
5. <https://www.sdcard.org/>
6. <https://sourceforge.net/projects/etcher.mirror/>
7. Google
8. Youtube
9. Amazon

RESOURCES / LINKS



QUESTIONS OR TESTIMONIALS?

GETTING STARTED USING RASPBERRY PI IN THE SHACK

(PART 1)

Jack Weaver – AA5VZ