

# Command your IoT Projects from the Terminal



```
GNU nano 7.2

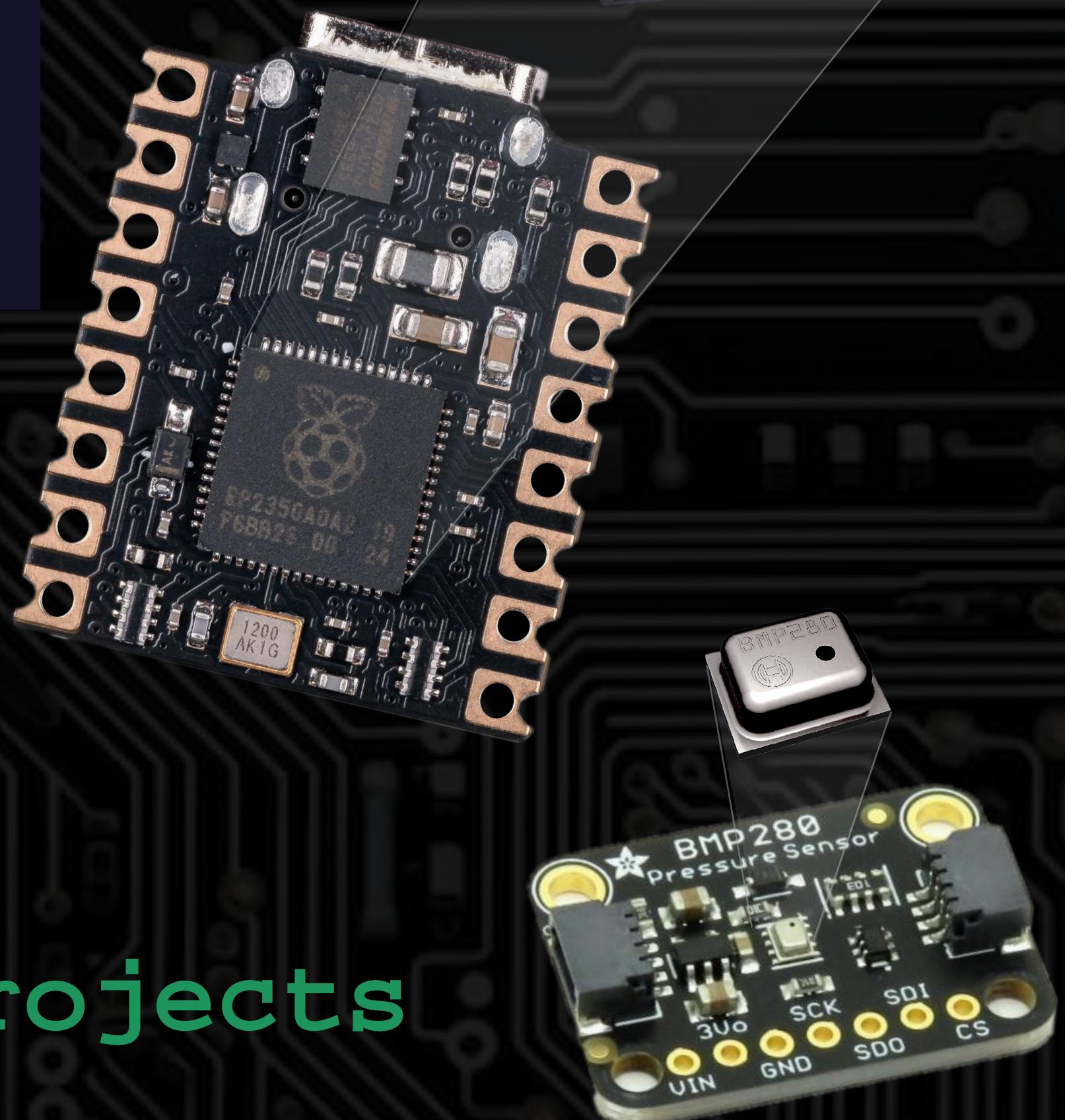
#if !defined(i2c_default) || !defined(PICO_DEFAULT_I2C_SDA_PIN) || !defined(PICO_DEFAULT_I2C_SCL_PIN)
    #warning i2c / bmp280_i2c example requires a board with I2C pins
    puts("Default I2C pins were not defined");
    return 0;
#else
    // useful information for picotool
    bi_decl(bi_2pins_with_func(PICO_DEFAULT_I2C_SDA_PIN, GPIO_FUNC_I2C));
    bi_decl(bi_program_description("BMP280 I2C"));
    set_function(PICO_DEFAULT_I2C_SDA_PIN, pull_up);
    set_function(PICO_DEFAULT_I2C_SCL_PIN, pull_up);
    printf("Hello, BMP280! Reading temperature\n");
    // I2C is "open drain", pull ups to keep
    i2c_init(i2c_default, 100 * 1000);
    gpio_set_function(PICO_DEFAULT_I2C_SDA_PIN, GPIO_FUNC_I2C);
    gpio_set_function(PICO_DEFAULT_I2C_SCL_PIN, GPIO_FUNC_I2C);
    gpio_pull_up(PICO_DEFAULT_I2C_SDA_PIN);
    gpio_pull_up(PICO_DEFAULT_I2C_SCL_PIN);

    // configure BMP280
    bmp280_init();

    // retrieve fixed compensation params
    struct bmp280_calib_param params;
    bmp280_get_calib_params(&params);

    int32_t raw_temperature;
    int32_t raw_pressure;

    sleep_ms(250); // sleep so that data polling and register update don't collide
    while (1) {
        bmp280_read_raw(&raw_temperature, &raw_pressure);
        int32_t temperature = bmp280_convert_temp(raw_temperature, &params);
        int32_t pressure = bmp280_convert_pressure(raw_pressure, raw_temperature, &params);
        printf("Pressure = %.3f kPa\n", pressure / 1000.f);
        printf("Temp. = %.2f C\n", temperature / 100.f);
        // poll every 500ms
        sleep_ms(500);
    }
#endif
```



# Terminal Setup



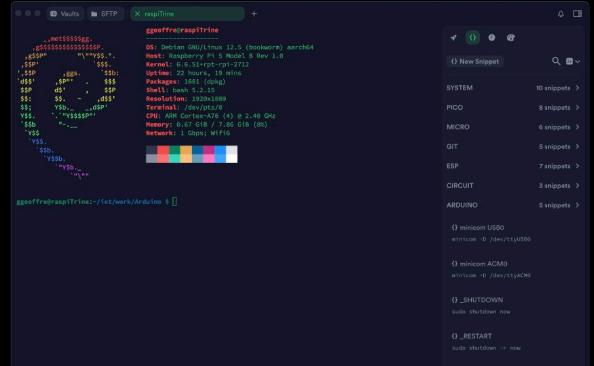
Apple  
Mac Studio  
M1 Ultra



Portable Monitor  
Keyboard Mouse



Apple  
iPad Pro M1  
Magic Keyboard



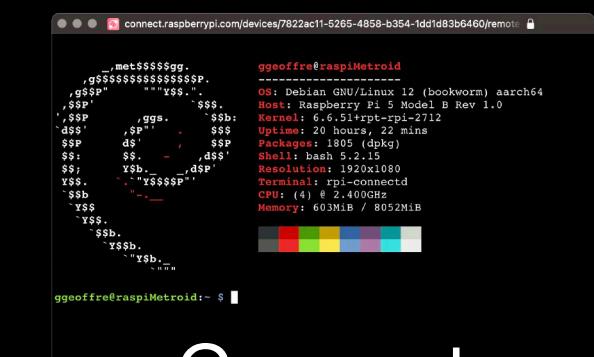
SSH Client  
(terminal)



VNC Client  
(remote desktop)



UVC Client  
(video capture)



Connect  
(service)

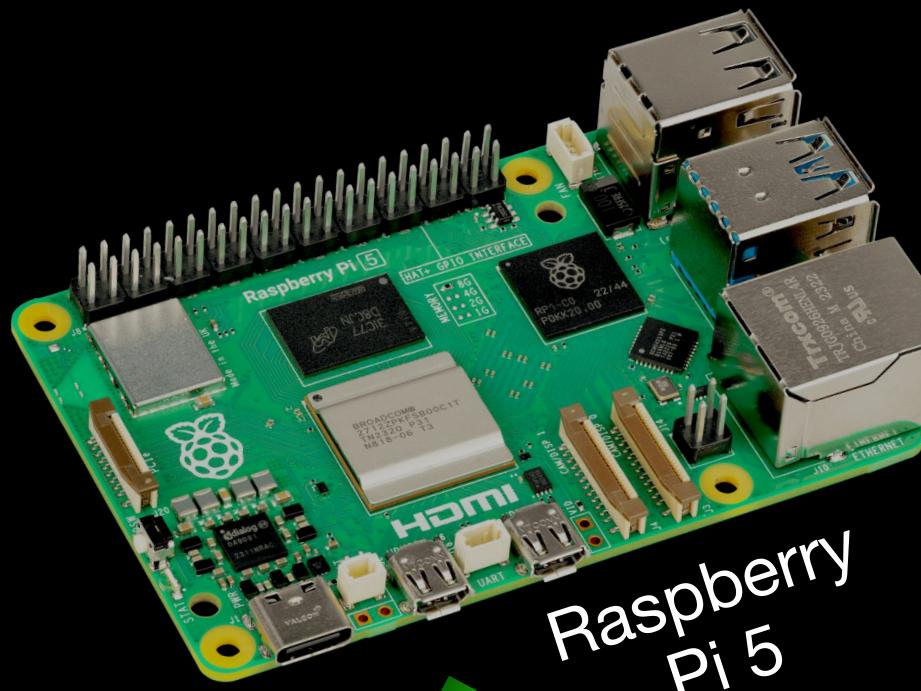
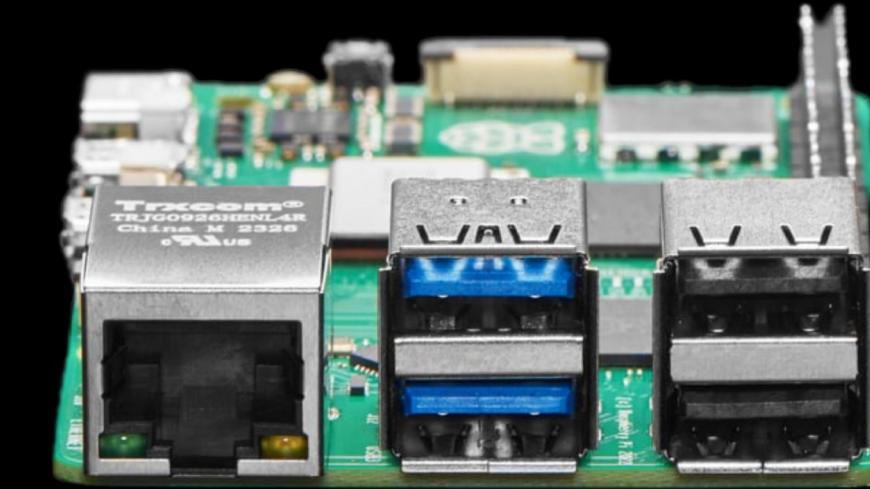
SSH  
(network)

VNC  
(network)

HDMI  
(wired)

OTG  
(gadget)

CONNECT  
(service)



Raspberry  
Pi 5



RP2040

/tty/ACM0  
BOOTSEL

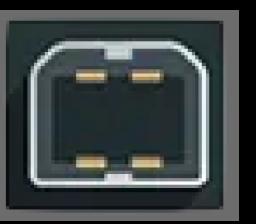
I<sup>2</sup>C



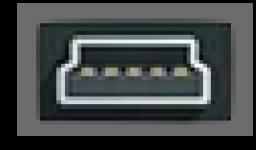
BMP280



USB-A



USB-B



Mini-USB



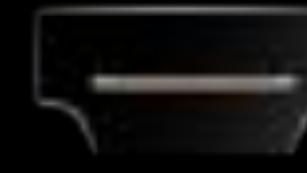
Micro-USB



USB-C



Ethernet



HDMI



Wi-Fi

# what exactly is a Terminal?

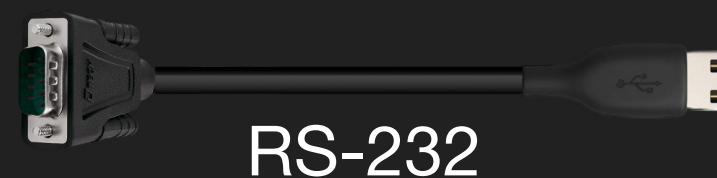


print a line, scroll up  
type a line, scroll up





SERIAL



Serial



I<sup>2</sup>C



BMP280



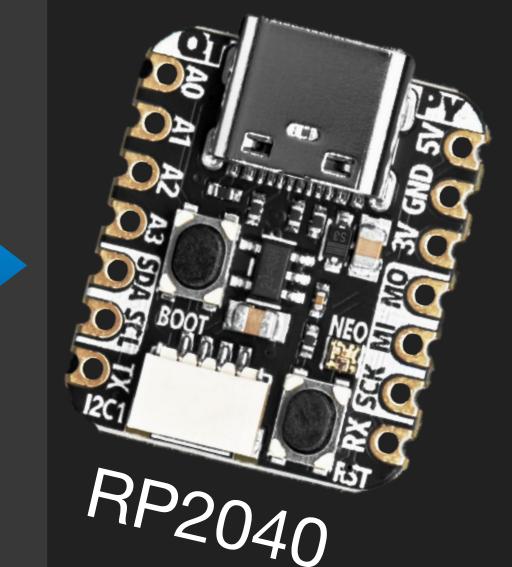
HDMI



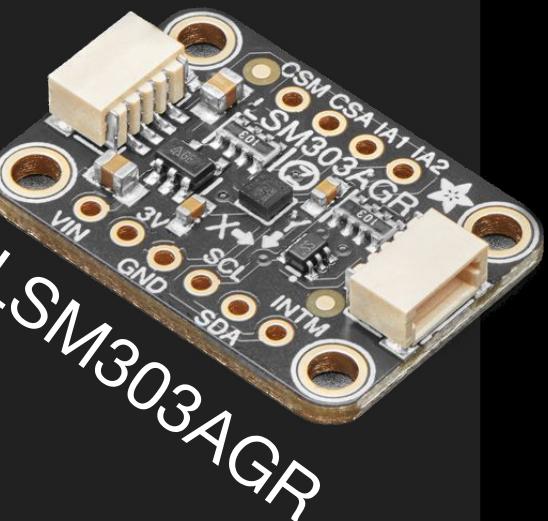
Portable/Desktop  
Monitor  
Keyboard Mouse



Serial



I<sup>2</sup>C



LSM303AGR



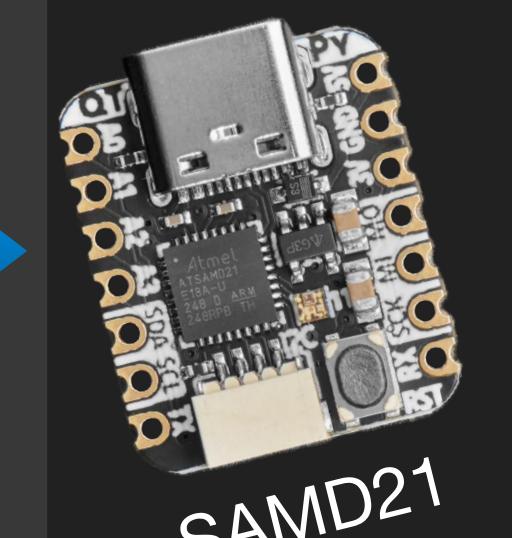
HDMI



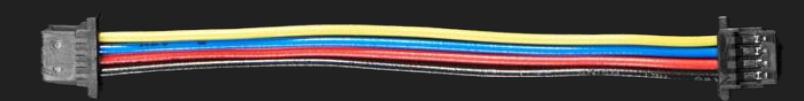
Video Capture Card



Serial

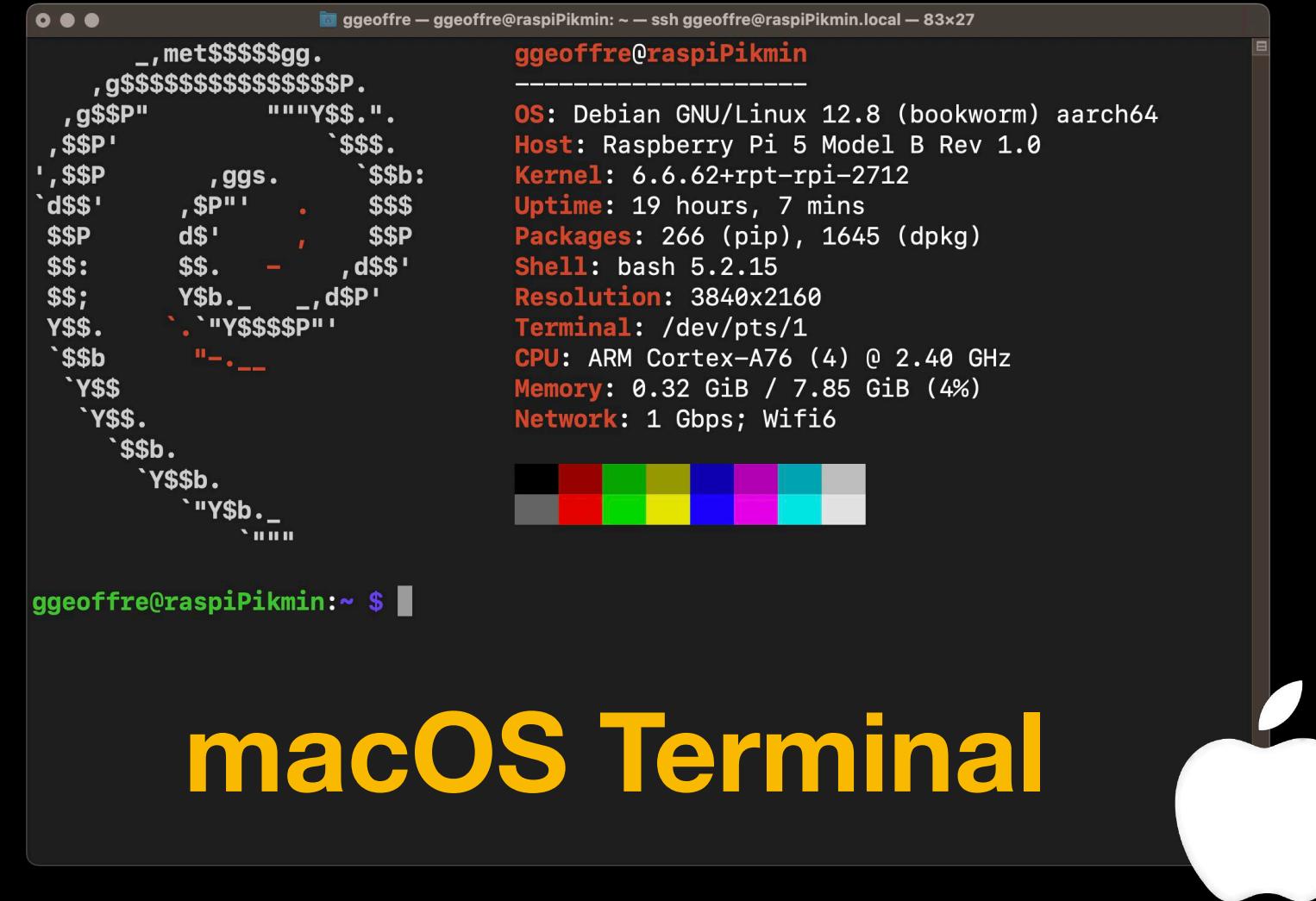


I<sup>2</sup>C



BH1750

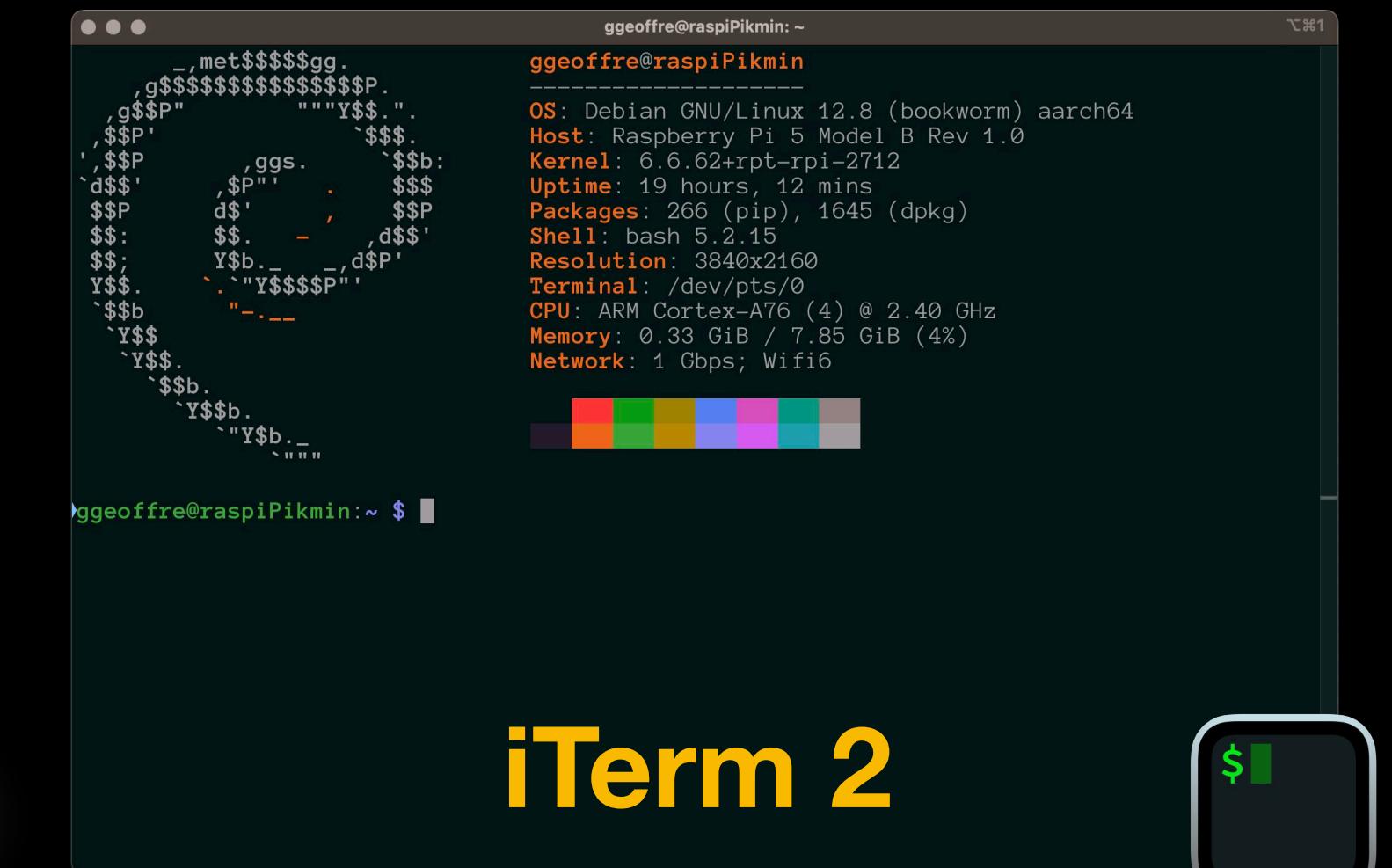
# But wait what about Terminal Emulators?



# macOS Terminal



# kitty



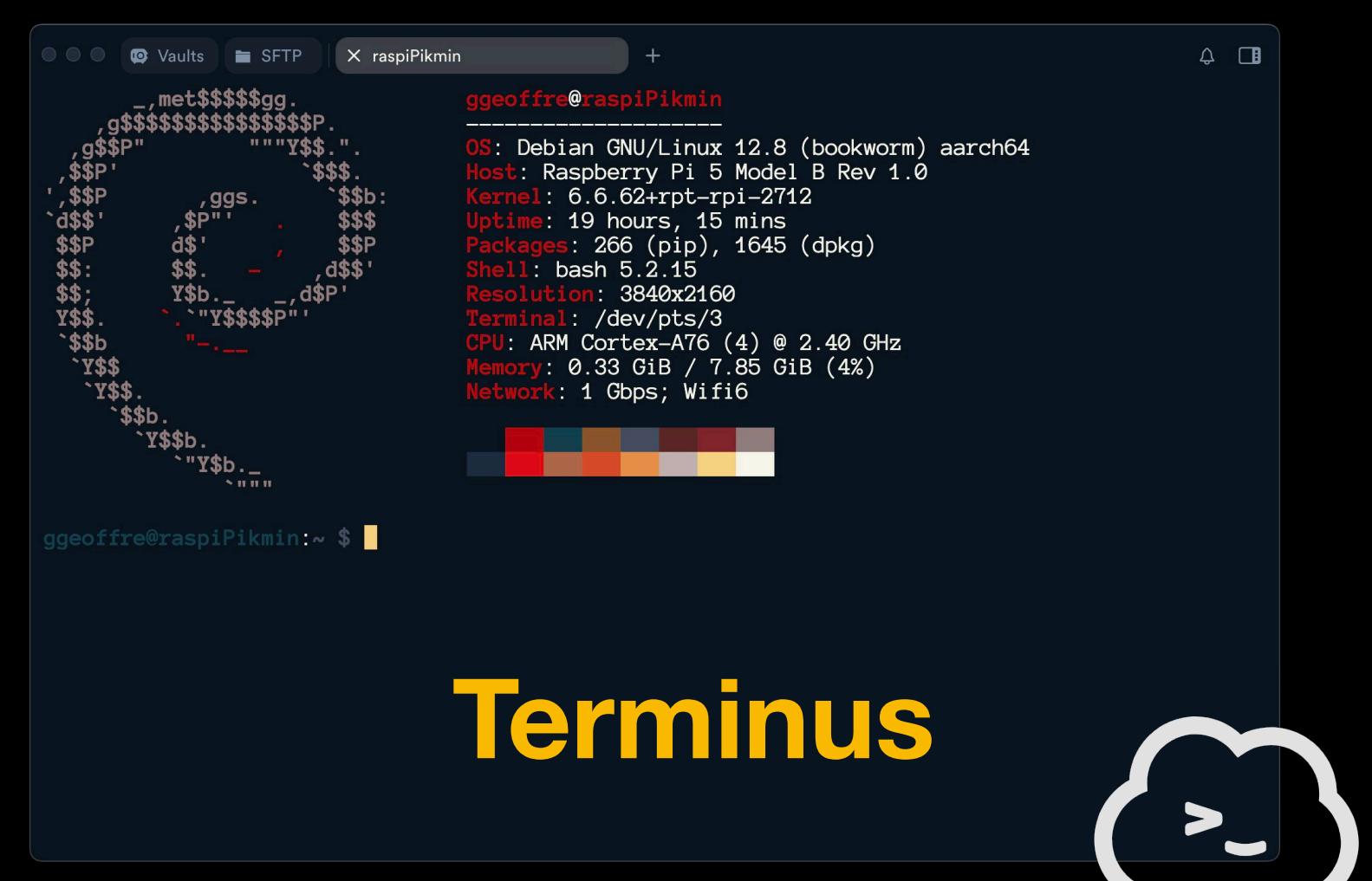
# iTerm 2



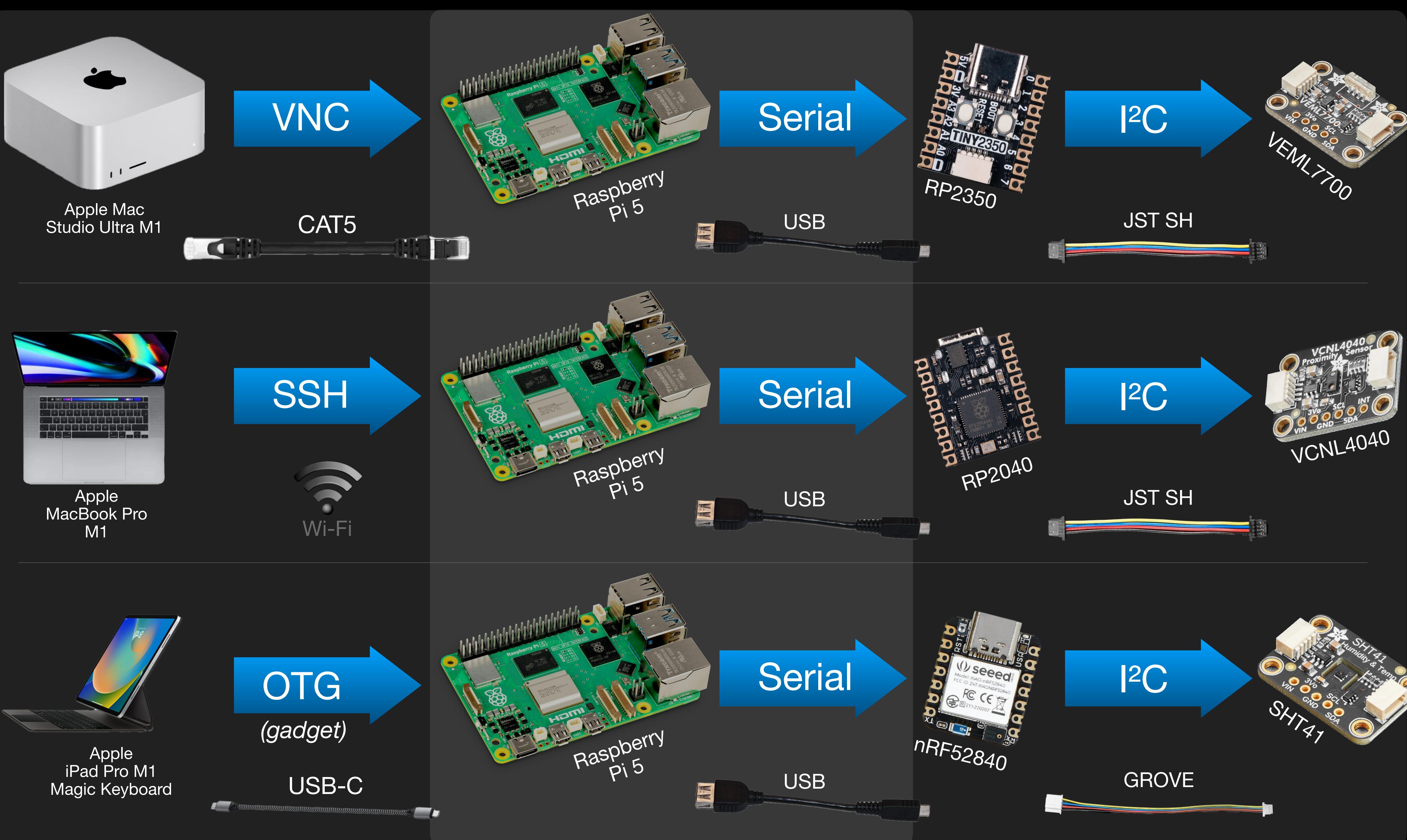
# ghostty



# Prompt 3



# Terminus



# Then what exactly is the shell?

sh  
csh  
ksh  
zsh  
bash  
pwshe



SH

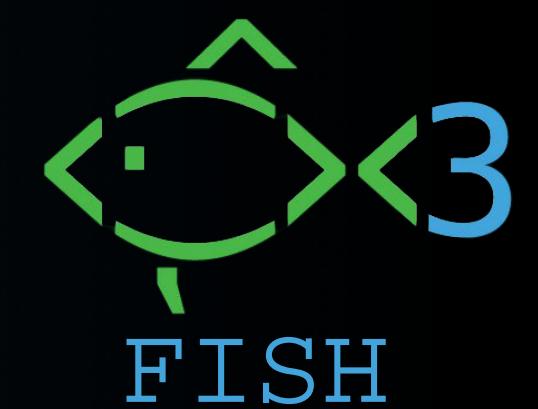


BASH

CSH

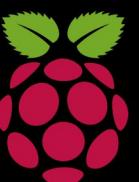
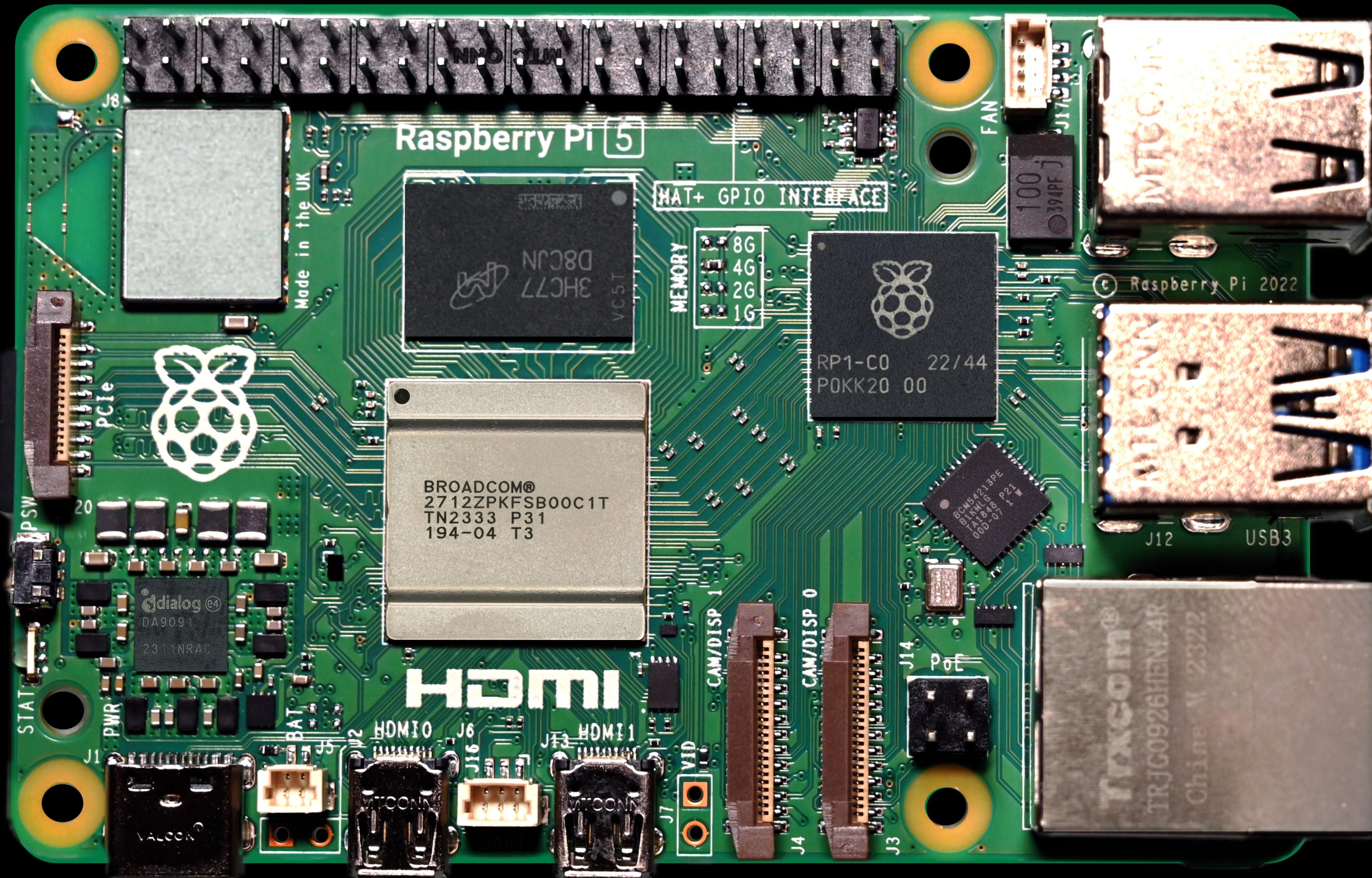
PWSH

zsh%

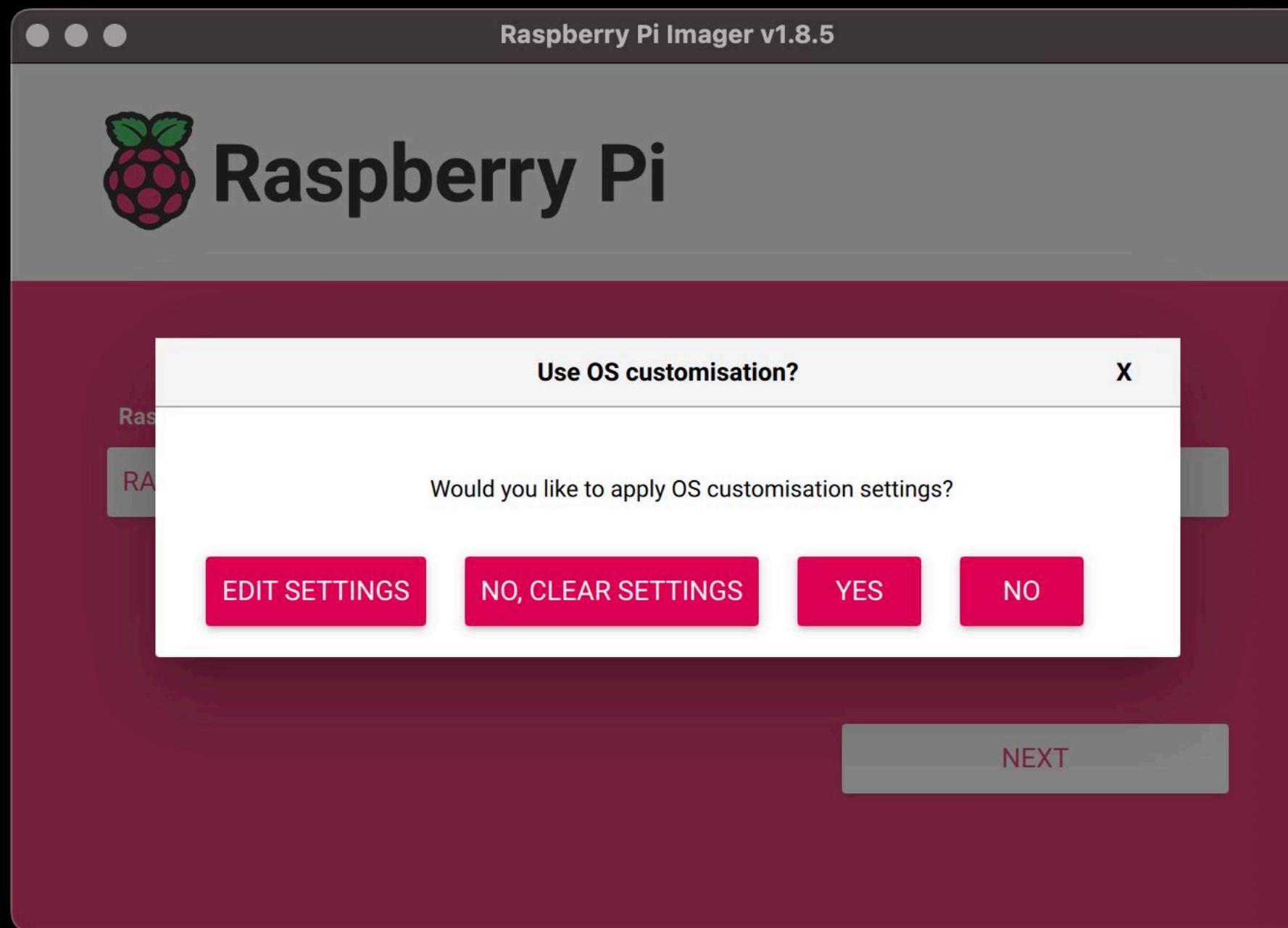


Ken Thompson

# Raspberry Pi



# Raspberry Pi Imager



A screenshot of the "OS Customisation" screen. At the top, there are three tabs: "GENERAL" (selected), "SERVICES", and "OPTIONS". The "GENERAL" tab contains several configuration options:

- Set hostname: .local
- Set username and password:  
Username:   
Password:
- Configure wireless LAN:  
SSID:   
Password:   
 Show password    Hidden SSID  
Wireless LAN country:
- Set locale settings:  
Time zone:   
Keyboard layout:

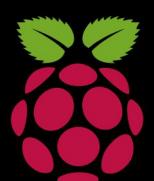
At the bottom right of the screen is a "SAVE" button.

A screenshot of the "OS Customisation" screen, showing the "SERVICES" tab. It contains the following configuration:

- Enable SSH
- Use password authentication
- Allow public-key authentication only  
Set authorized\_keys for 'userId':

At the bottom right of the screen is a "SAVE" button.

rpilocator.com



# Raspberry Pi Config

## 1 System Options

Raspberry Pi Software Configuration Tool (raspi-config)

S1 Wireless LAN	Enter SSID and passphrase
S2 Audio	Select audio out through HDMI or 3.5mm jack
S3 Password	Change password for the 'ggeoffre' user
<b>S4 Hostname</b>	<b>Set name for this computer on a network</b>
S5 Boot / Auto Login	Select boot into desktop or to command line
S6 Splash Screen	Choose graphical splash screen or text boot
S7 Power LED	Set behaviour of power LED
S8 Browser	Choose default web browser

<Select>      <Back>

## 3 Interface Options

Raspberry Pi Software Configuration Tool (raspi-config)

I1 SSH	Enable/disable remote command line access using SSH
I2 RPi Connect	Enable/disable Raspberry Pi Connect
<b>I3 VNC</b>	<b>Enable/disable graphical remote desktop access</b>
I4 SPI	Enable/disable automatic loading of SPI kernel module
I5 I2C	Enable/disable automatic loading of I2C kernel module
I6 Serial Port	Enable/disable shell messages on the serial connection
I7 1-Wire	Enable/disable one-wire interface
I8 Remote GPIO	Enable/disable remote access to GPIO pins

<Select>      <Back>

## 6 Advanced Options

Raspberry Pi Software Configuration Tool (raspi-config)

<b>A1 Expand Filesystem</b>	<b>Ensures that all of the SD card is available</b>
A2 Network Interface Names	Enable/disable predictable network i/f names
A3 Network Proxy Settings	Configure network proxy settings
A4 Boot Order	Choose SD, network, USB or NVMe device boot priority
A5 Bootloader Version	Select latest or factory default bootloader software
A6 Wayland	Switch between X and Wayland backends
A7 Audio Config	Set audio control system
A8 PCIe Speed	Set PCIe x1 port speed

<Select>      <Back>

Wireless LAN\*

**Hostname**

SSH\*

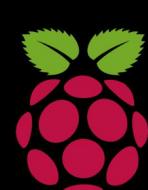
RPi Connect\*

**VNC**

I2C

**Expand Filesystem**

Boot Order\*



# Raspberry Pi Connect

```
sudo apt update
```

```
sudo apt full-upgrade
```

```
sudo apt install rpi-connect
```

```
sudo apt install rpi-connect rpi-connect-lite
```

```
sudo reboot
```

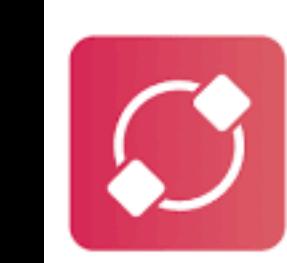
```
systemctl --user start rpi-connect
```

```
rpi-connect signin
```

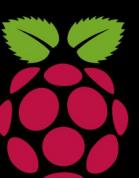
Complete sign in by visiting

<https://connect.raspberrypi.com/verify/XXXX-XXXX>

NOTE: finish the rest of the setup via any browser on some other computer, laptop, phone or tablet...



Raspberry Pi  
Connect Beta



# Raspberry Pi USB Gadget



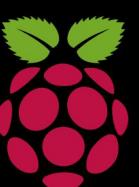
A screenshot of a web browser displaying the Raspberry Pi Forums. The URL is forums.raspberrypi.com/viewtopic.php?t=376578. The page shows a topic titled '[HOWTO] Headless configuration of a Raspberry Pi using USB Ethernet Gadget on Beowulf' by phattmatt. The topic has 5 replies, 734 views, and was last posted on Thu Oct 24, 2024 at 12:32 pm. Below the topic, there are two other topics listed as STICKY: HOWTO posts.

## Raspberry Pi Forums - Topic 376578

<https://forums.raspberrypi.com/viewtopic.php?t=376578>

- Edit ‘config.txt’ and ‘cmdline.txt’ per instructions in the topic’s post...
- Download/edit/run script in the topic’s post...
- Reboot, check with **ifconfig**...

```
usb0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
      inet 169.254.133.86  netmask 255.255.0.0  broadcast 169.254.255.255
      inet6 fe80::15dd:9047:cee6:391b  prefixlen 64  scopeid 0x20<link>
      ether ea:46:11:1b:0b:c1  txqueuelen 1000  (Ethernet)
        RX packets 284  bytes 46679 (45.5 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 326  bytes 285229 (278.5 KiB)
        TX errors 0  dropped 0  overruns 0  carrier 0  collisions 0
```



# Raspberry Pi USB Gadget

Thank You  
PHATTMATT



```
arp -a | grep :  
arp -a | grep bridge
```

```
sudo ip link set eth0 down  
sudo ip link set wlan0 down
```

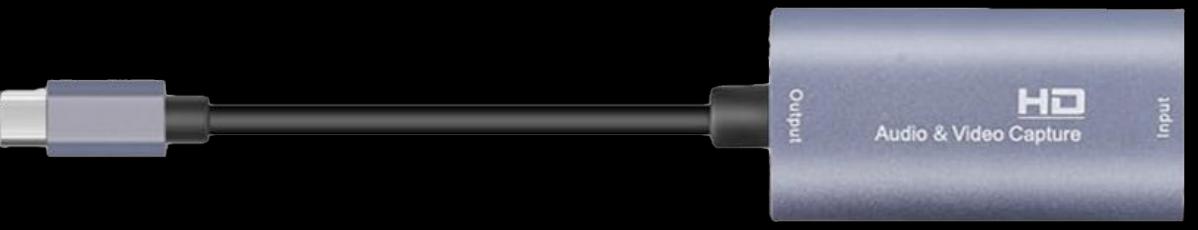
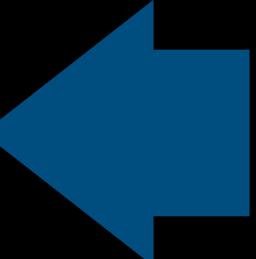
```
ssh ggeoffre@192.168.2.10
```



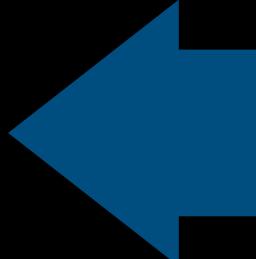
# Raspberry Pi HDMI Output



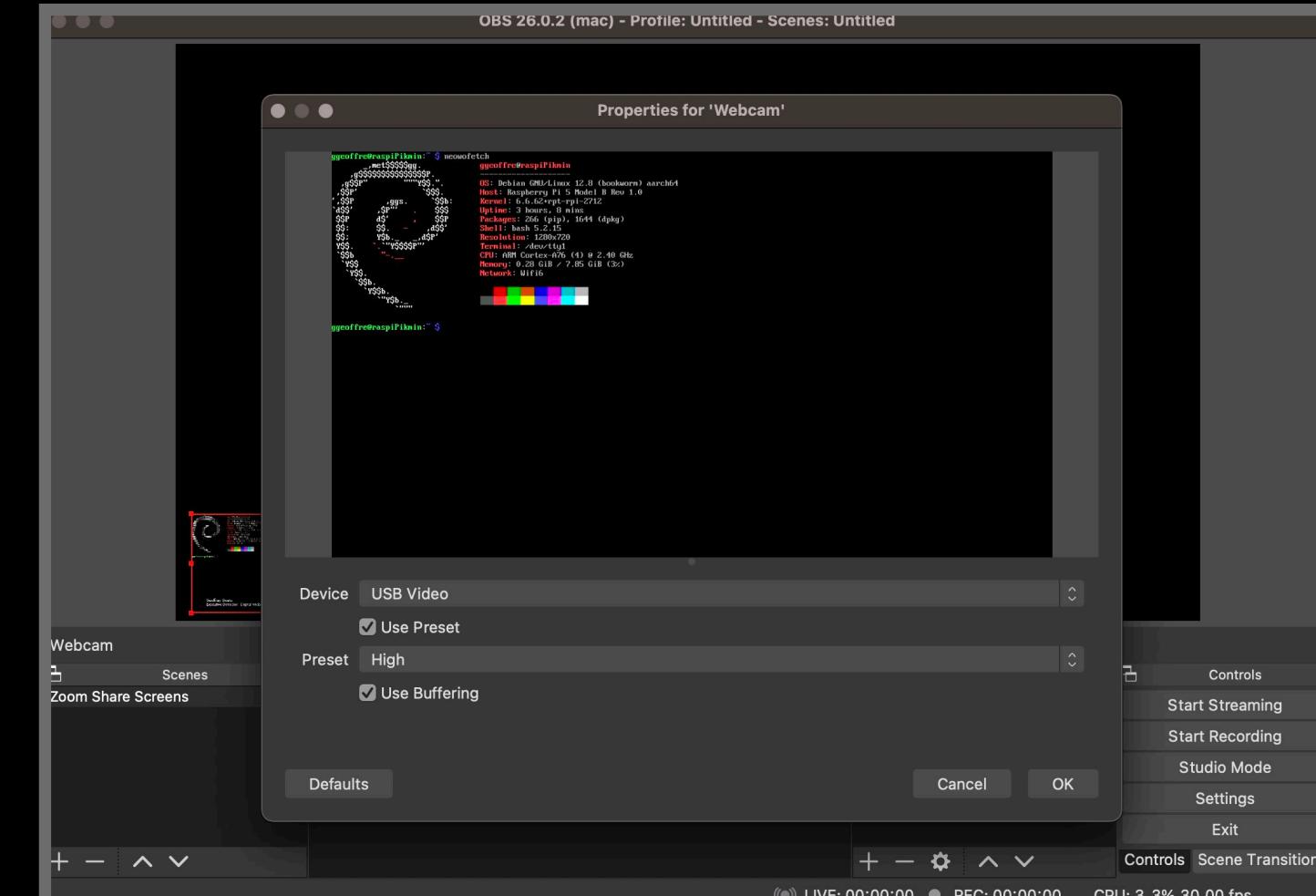
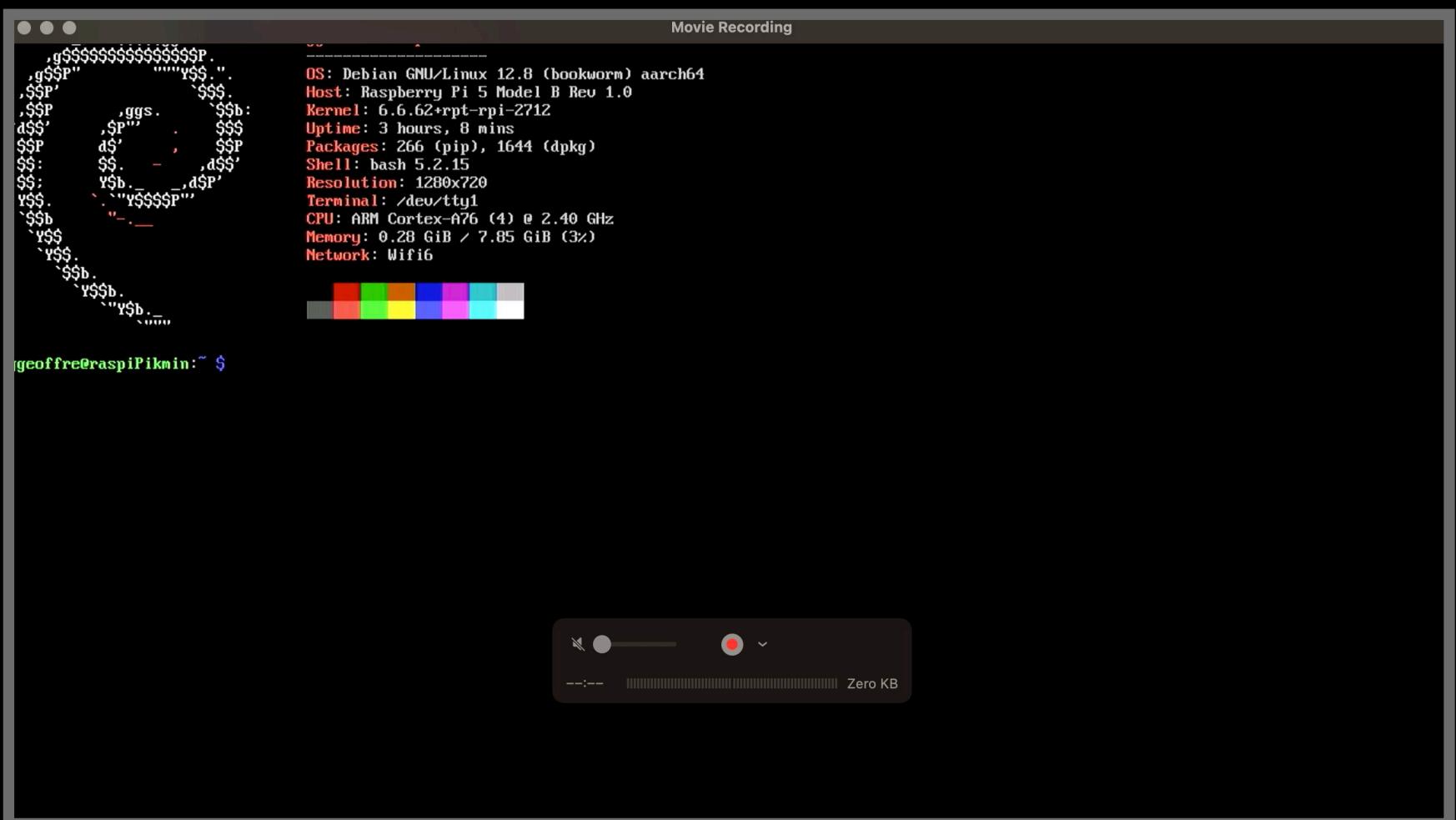
MacBook



**USB to HDMI**  
*Video Capture*



Raspberry Pi



QuickTime > New Movie Recording > USB Video

OBS > Video Capture Device Source



# Raspberry Pi RS-232 Output



**WYSE**



**PI**

```
ls /dev/*USB* | grep tty
```

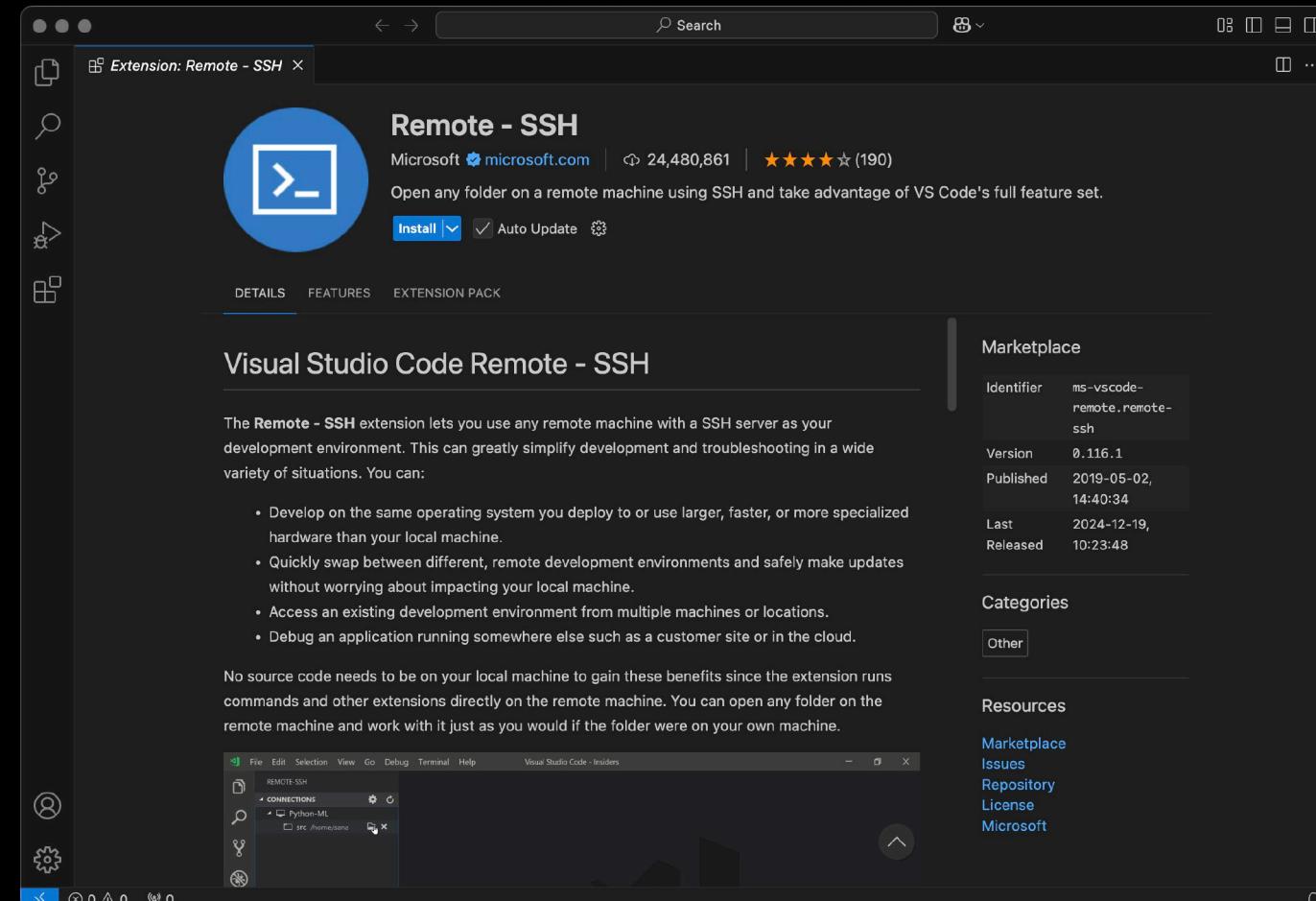
```
sudo systemctl enable serial-getty@ttyUSB0.serviceminicom
```

**Modern Linux on a Wyse Terminal**

<https://www.youtube.com/watch?v=xQTr9ZOJkC0>

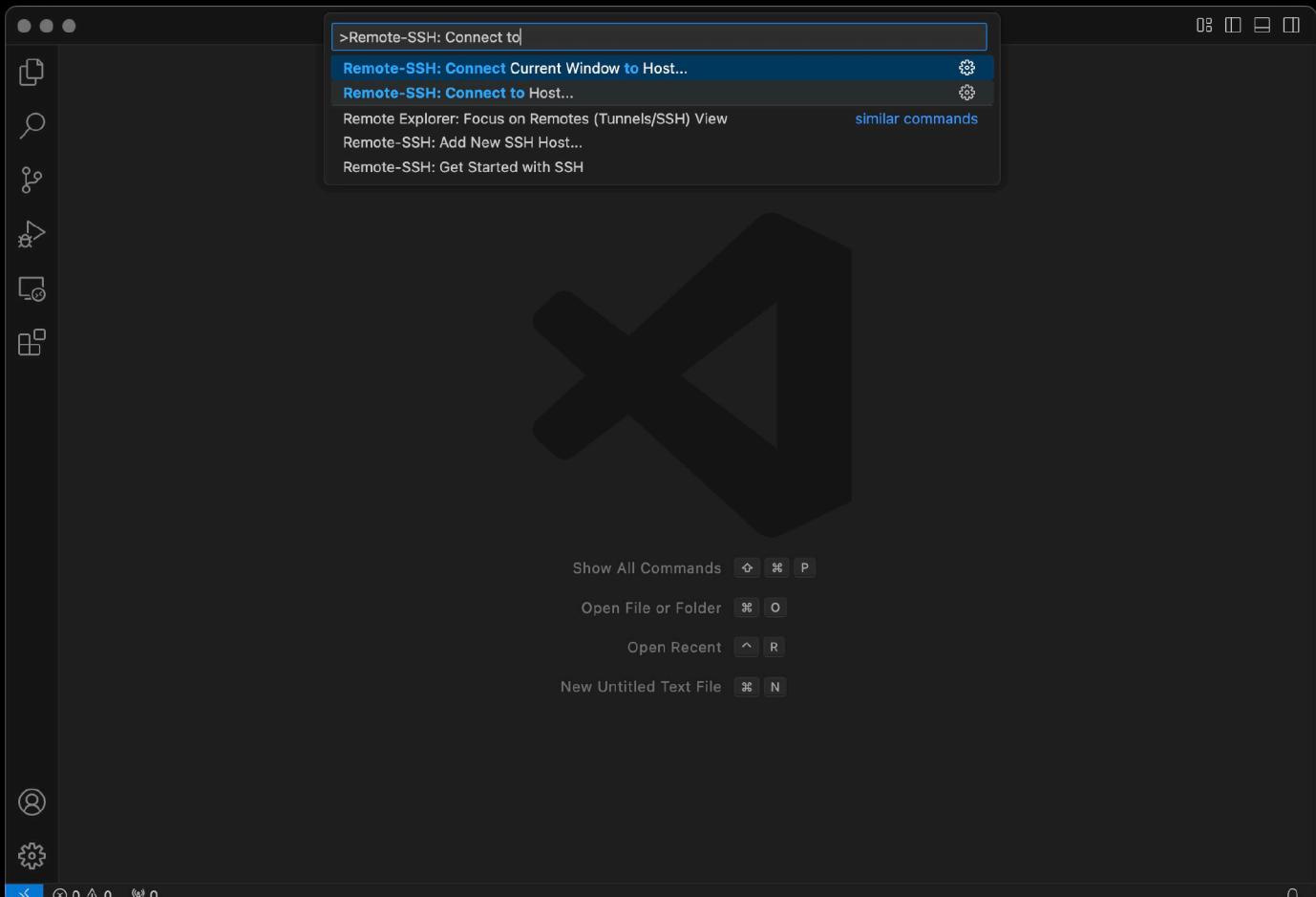
# Visual Studio Code - Remote SSH

## Install

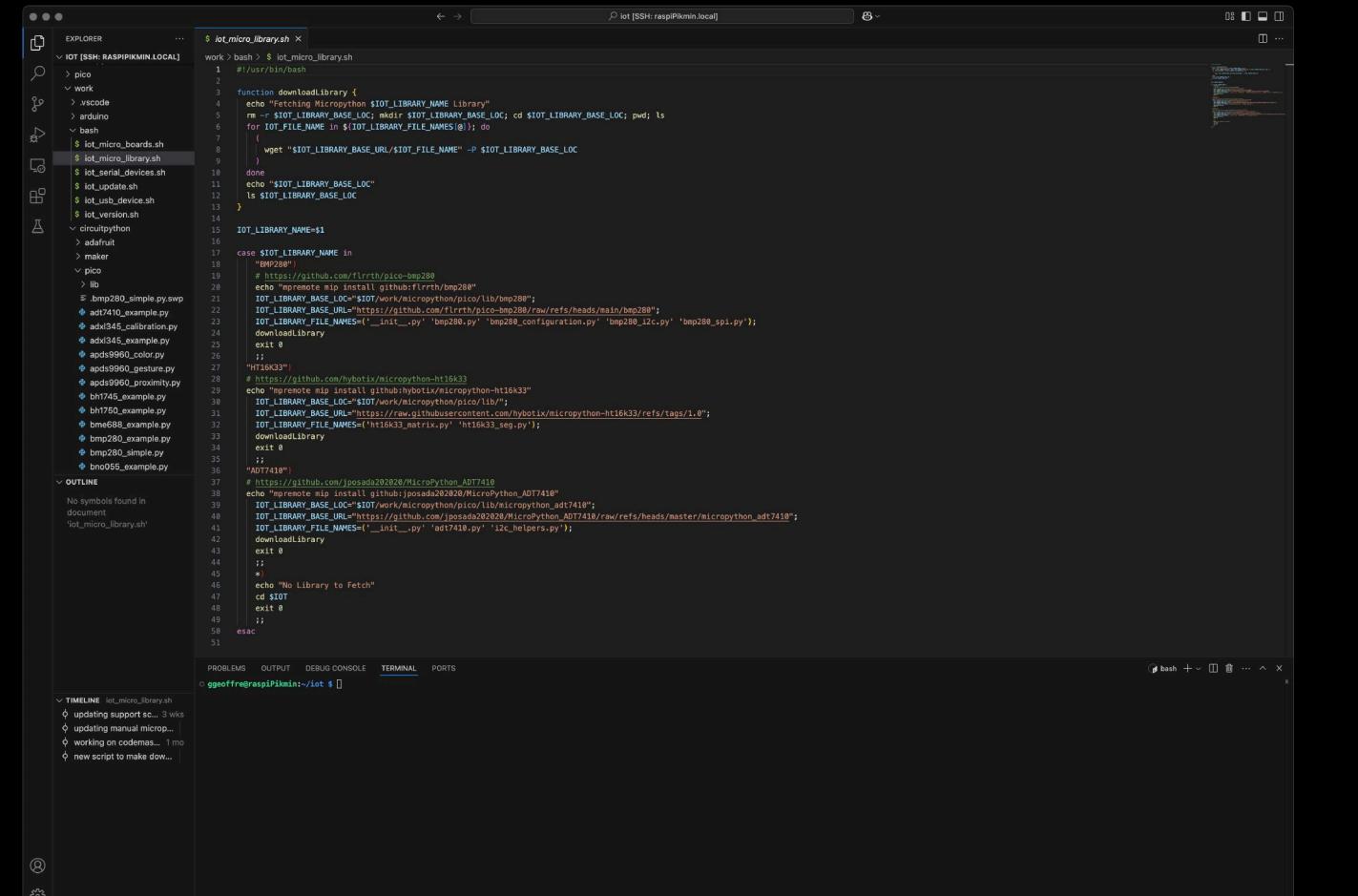


Visual Studio Code Remote  
SSH / Editing Configuration Files / Explorer

## Connect



from the Command Palette  
select *Remote-SSH: Connect to Host...*



Remotely Edit Files  
understands 'remote' versioning

## Visual Studio Code - Remote Development Over SSH

<https://code.visualstudio.com/docs/remote/ssh-tutorial>



# Fonts and Colors

## True Type Font

Anonymous Pro  
Mark Simonson  
STUDIO

abcdefghijklmnopqrstuvwxyz  
ABCDEFGHIJKLMNOPQRSTUVWXYZ  
0123456789[]{}()<>\\

## Terminal Font

```
# CONFIGURATION FILE FOR SETUPCON
ACTIVE_CONSOLES="/dev/tty[1-6]"
CHARMAP="UTF-8"
CODESET="guess"
FONTFACE="Terminus"
FONTSIZE="16x32"
```

```
grep -n FONTFACE /etc/default/console-setup
echo $TERM; sudo showconsolefont -vvi
→ sudo dpkg-reconfigure console-setup
ls /usr/share/consolefonts/*.psf.gz
setfont /usr/share/consolefonts/*.psf.gz
```

# Fonts and Colors

## WCAG - accessibility standard for color contrast

- AA minimum contrast ratio of 4.50:1
- AAA minimum contrast ratio of 7.00:1

```
[1: demo tempus *] 2: cdin $ 3: diff files # Default $0
1. The "tempus-themes-generator" repo is the tool that is used to build
the Tempus themes. All contributions to the underlying code should
be done here.
2. The [Tempus Themes](https://gitlab.com/protesilaos/tempus-themes) is
the main user-facing repository. It contains all the files
pertaining to the themes, as well as general information on
the project as a whole.
3. For example, there are template files there is a dedicated repository
on GitLab (exceptions are generic data files, such as YAML ports).
Their naming convention follows this pattern: "tempus-themes-[NAME OF
TEMPLATES]" For example, "tempus-themes-xfce-terminal" contains
10,21
while IFS=$'\n' read -r line; do
    echo -n "$line"
done
```

```
[1: demo tempus *] 2: cdin $ 3: diff files #
active_theme="$my_colours/active-tempus-theme.sh"
active_theme_content="$my_colours/active-theme-content"
# Check if the content of the active theme is present, else exit.
[ -f "$active_theme" ] || { echo "ERROR: No available Tempus theme."; exit 1; }
# This cleans up the file that contains all the colour values. It only
# keeps the ones we will be using over this array to print the table with
# the colours.
tempus_palettes=()
for hex in ${hexes[@]}; do
    tempus_palettes+=("$hex")
done
41,21 44%
tempus-themes-generator/
presets/ CHANGELOG LICENSE
schemas/ README.md
templates/ CONTRIBUTING.md tempus-themes-generator.sh
-/tempus-themes-generator $
```

```
#/tempus-themes-generator/schemes $ ls
autumn dark_foxfire frosty tempest warp
classic day fugit night rift summer totus winter
-/tempus-themes-generator/schemes $
```

```
rm
presviews konsole shell-variables tilix vim xfce-terminal yaru
-/tempus-themes-generator/templates $
```

```
1.0.20190523 (HEAD -> master, origin/master, origin/HEAD) Update to version 1.0.20190523
bf7f7d6 Remove comments from all scheme files
8581737 Do not parse vim swap files
937f533 Update the CONTRIBUTING file
17fabe6 Fix type for <code>Tempus</code>
8581737 Fix type for <code>Tempus</code>
8581737 Update to v1.0.2,20190530
17fabe6 Update to v1.0.2,20190523
8581737 Update to v1.0.1,20190523
8581737 Use reverse video for search highlighting.
8581737 Fix grep to only match whole words
8581737 Update CHANGELOG
8581737 (tempus-themes-generator, rewriteGenerator) BREAKING CHANGE: Rewire
tempus generator script
-/dotfiles/bin/$
```

Tempus Autumn (WCAG AA)

```
[1: demo tempus *] 2: cdin $ 3: diff files #
active_theme="$my_colours/active-tempus-theme.sh"
active_theme_content="$my_colours/active-theme-content"
# Check if the content of the active theme is present, else exit.
[ -f "$active_theme" ] || { echo "ERROR: No available Tempus theme."; exit 1; }
# This cleans up the file that contains all the colour values. It only
# keeps the ones we will be using over this array to print the table with
# the colours.
tempus_palettes=()
for hex in ${hexes[@]}; do
    tempus_palettes+=("$hex")
done
41,21 44%
tempus-themes-generator/
presets/ CHANGELOG LICENSE
schemas/ README.md
templates/ CONTRIBUTING.md tempus-themes-generator.sh
-/tempus-themes-generator $
```

```
#/tempus-themes-generator/schemes $ ls
autumn dark_foxfire frosty tempest warp
classic day fugit night rift summer totus winter
-/tempus-themes-generator/schemes $
```

```
rm
presviews konsole shell-variables tilix vim xfce-terminal yaru
-/tempus-themes-generator/templates $
```

```
1.0.20190523 (HEAD -> master, origin/master, origin/HEAD) Update to version 1.0.20190523
bf7f7d6 Remove comments from all scheme files
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8581737 Update to v1.0.1,20190523
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8581737 Fix grep to only match whole words
8581737 Update CHANGELOG
8581737 (tempus-themes-generator, rewriteGenerator) BREAKING CHANGE: Rewire
tempus generator script
-/dotfiles/bin/$
```

Tempus Tempest (WCAG AA)

```
[1: demo tempus *] 2: cdin $ 3: diff files #
active_theme="$my_colours/active-tempus-theme.sh"
active_theme_content="$my_colours/active-theme-content"
# Check if the content of the active theme is present, else exit.
[ -f "$active_theme" ] || { echo "ERROR: No available Tempus theme."; exit 1; }
# This cleans up the file that contains all the colour values. It only
# keeps the ones we will be using over this array to print the table with
# the colours.
tempus_palettes=()
for hex in ${hexes[@]}; do
    tempus_palettes+=("$hex")
done
41,21 44%
tempus-themes-generator/
presets/ CHANGELOG LICENSE
schemas/ README.md
templates/ CONTRIBUTING.md tempus-themes-generator.sh
-/tempus-themes-generator $
```

```
#/tempus-themes-generator/schemes $ ls
autumn dark_foxfire frosty tempest warp
classic day fugit night rift summer totus winter
-/tempus-themes-generator/schemes $
```

```
rm
presviews konsole shell-variables tilix vim xfce-terminal yaru
-/tempus-themes-generator/templates $
```

```
1.0.20190523 (HEAD -> master, origin/master, origin/HEAD) Update to version 1.0.20190523
bf7f7d6 Remove comments from all scheme files
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937f533 Update the CONTRIBUTING file
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8581737 Fix type for <code>Tempus</code>
8581737 Update to v1.0.2,20190530
17fabe6 Update to v1.0.2,20190523
8581737 Update to v1.0.1,20190523
8581737 Use reverse video for search highlighting.
8581737 Fix grep to only match whole words
8581737 Update CHANGELOG
8581737 (tempus-themes-generator, rewriteGenerator) BREAKING CHANGE: Rewire
tempus generator script
-/dotfiles/bin/$
```

Tempus Warp (WCAG AA)

<https://gitlab.com/protesilaos/tempus-themes>

<https://iterm2colorsschemes.com/>

# Fonts and Colors

# ~/.bashrc

```
if [ "$TERM" = "linux" ]; then
    echo -en "\e]P0001514" #black
    echo -en "\e]P1ff3737" #darkred
    echo -en "\e]P2169c16" #darkgreen
    echo -en "\e]P39f8500" #brown
    echo -en "\e]P45781ef" #darkblue
    echo -en "\e]P5da4ebf" #darkmagenta
    echo -en "\e]P6009880" #darkcyan
    echo -en "\e]P7968282" #lightgrey
    echo -en "\e]P8261c2c" #darkgrey
    echo -en "\e]P9F0681A" #red
    echo -en "\e]PA3aa73a" #green
    echo -en "\e]PBba8a00" #yellow
    echo -en "\e]PC8887f0" #blue
    echo -en "\e]PDd85cf2" #magenta
    echo -en "\e]PE1dalaf" #cyan
    echo -en "\e]PFa29fa0" #white
    clear #for background artifacting
fi
```

# color\_test.sh

```
for FGs in '      m' '      1m' '      30m' '1;30m' '      31m'
'1;31m' '      32m' '1;32m' '      33m' '1;33m' '      34m' '1;34m'
'      35m' '1;35m' '      36m' '1;36m' '      37m' '1;37m';
do
    FG=${FGs// /};
    echo -en " $FGs \033[$FG $T ";
    for BG in 40m 41m 42m 43m 44m 45m 46m 47m;
    do
        echo -en "$EINS \033[$FG\033[$BG Text \033[0m";
    done;
    echo;
done
```

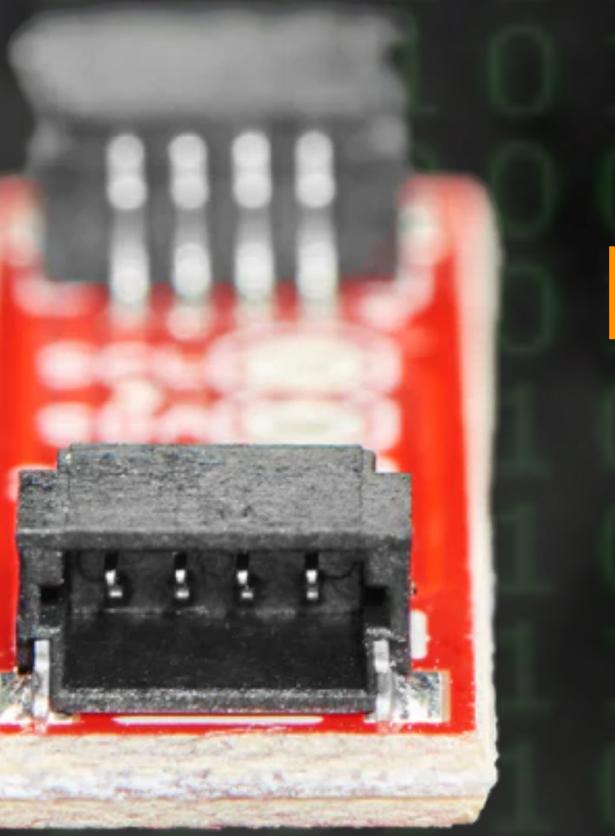
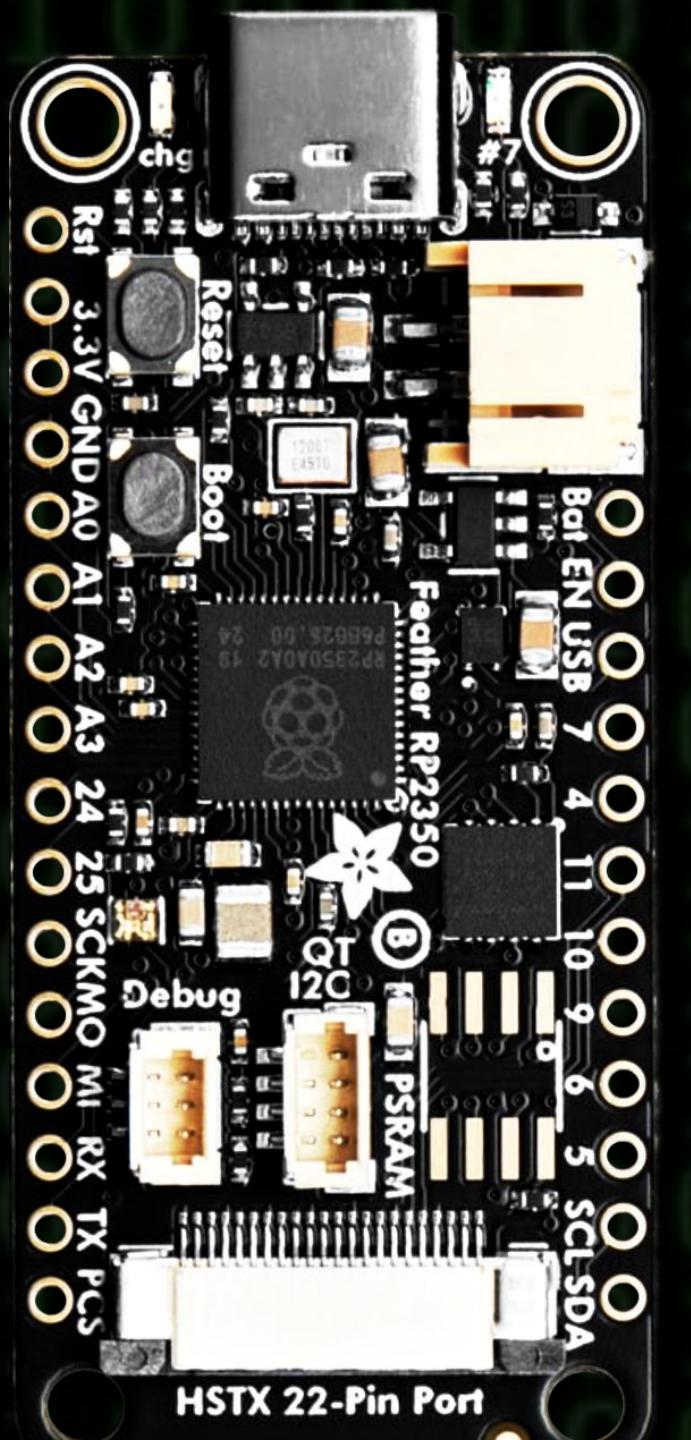
# What is an IoT Project?

PROGRAM A

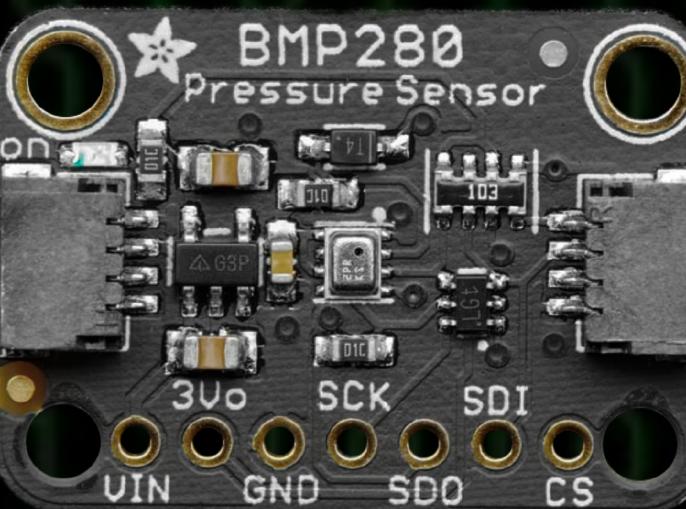
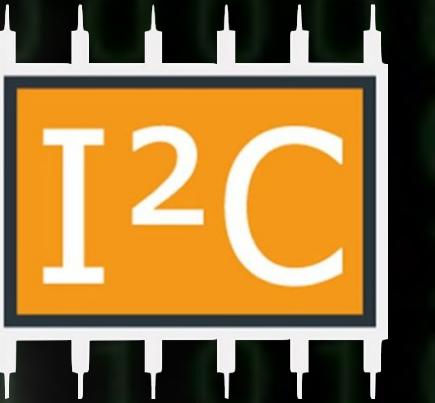
Microcontroller

chip pins boards

platforms



connectors



TO CONTROL

Electronic Circuits

protocols boards pins chips

# Platforms

MULTI



**MicroPython**

**pyboard**

 **Python**



**CircuitPython**

 **Python**

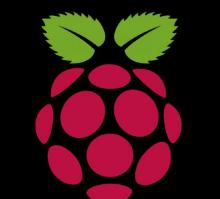


**Arduino**

**arduino-cli**

 **C/C++**

SINGLE



**Pico SDK**

**cmake/make**

 **C/C++**



**ESP-IDF**

**idf.py**

 **C/C++**

# Runtimes

INTERPRETED



**MicroPython**

**pyboard**

 **Python**



**CircuitPython**

 **Python**

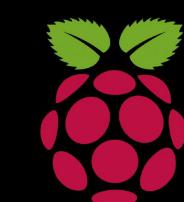
COMPILED



**Arduino**

**arduino-cli**

 **C/C++**



**Pico SDK**

**cmake/make**

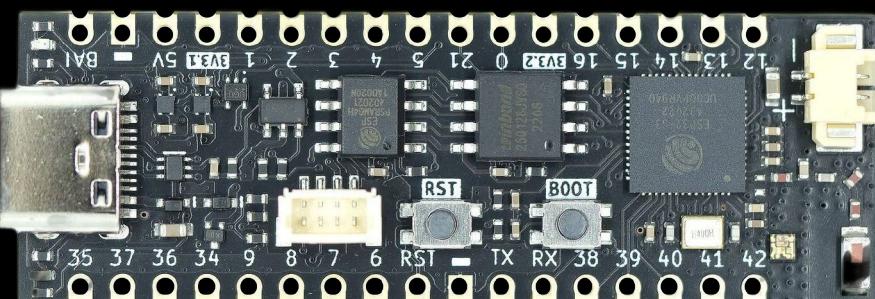
 **C/C++**



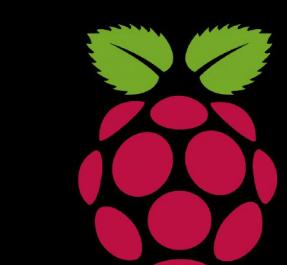
**ESP-IDF**

**idf.py**

 **C/C++**

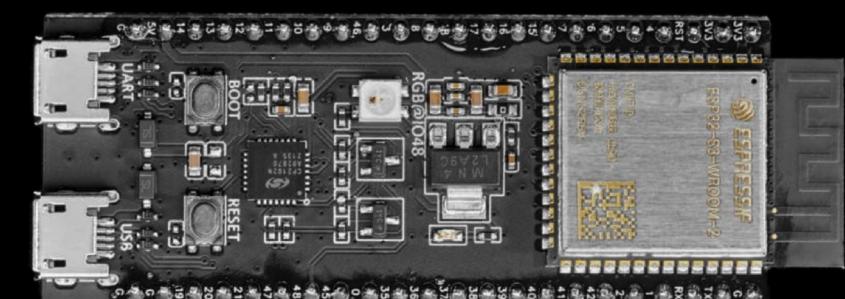


Unexpected Maker ProS3



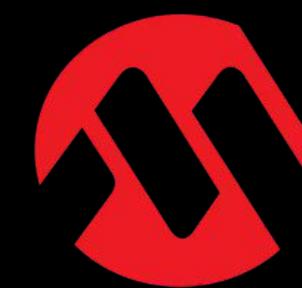
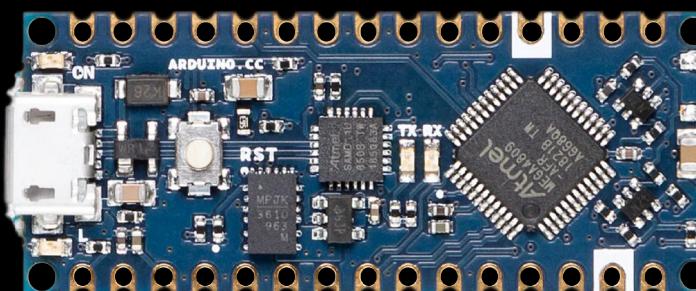
Raspberry Pi Pico W

- **ESP-IDF**
- **Arduino**
- **MicroPython**
- **CircuitPython**

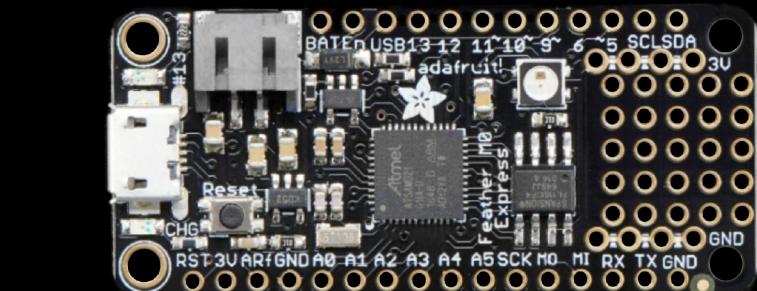


ESP32-S3

- **ESP-IDF**
- **Arduino**
- **MicroPython**
- **CircuitPython**

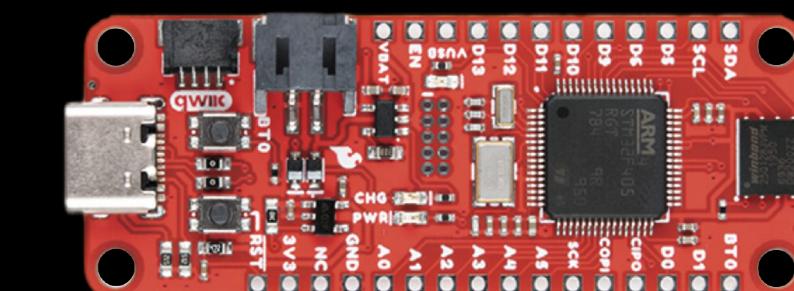


Arduino Nano Every



Adafruit M0 Express

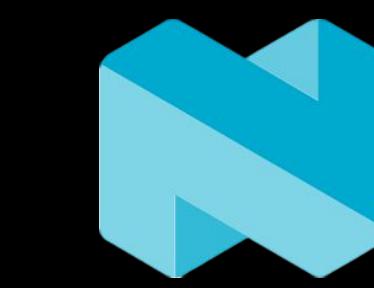
- **Arduino**



SparkFun Thing Plus

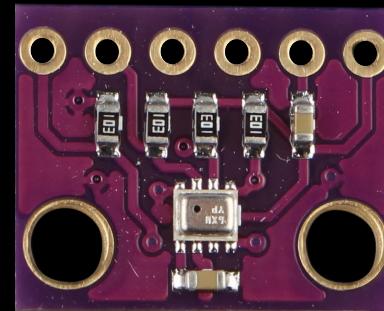
STM32

- **Arduino**
- **CircuitPython**



seeed XAIO nRF52840

- **Arduino**
- **MicroPython**
- **CircuitPython**



BMP280

- Pico-SDK
- ESP-IDF
- Arduino
- MicroPython
- CircuitPython

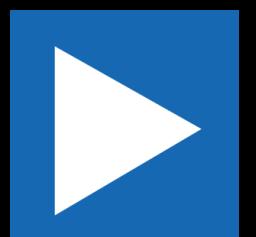


LIS3MDL

- Pico-SDK
- ESP-IDF
- Arduino
- MicroPython
- CircuitPython

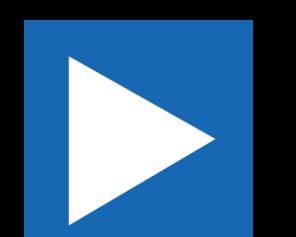


- Arduino
- PIMORONI

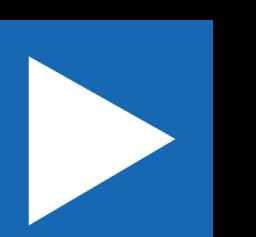


ANALOG  
DEVICES

- Arduino
- CircuitPython

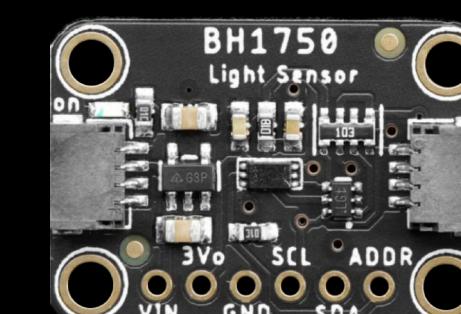


ADT7410



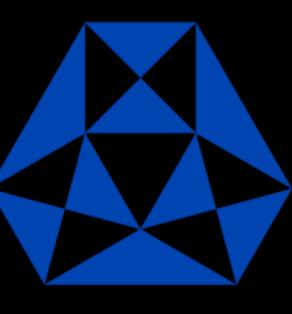
ANALOG  
DEVICES

- Arduino
- MicroPython
- CircuitPython



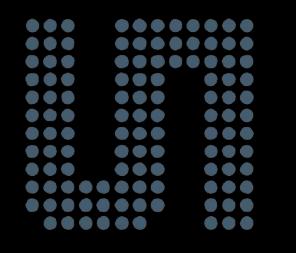
BH1750

- Pico-SDK
- ESP-IDF
- Arduino
- MicroPython
- CircuitPython



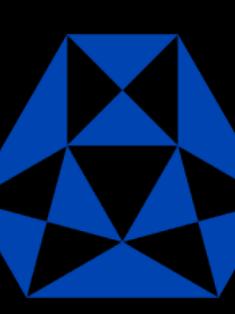
- Pico-SDK
- ESP-IDF
- Arduino
- MicroPython
- CircuitPython

MPU6050



TSL2591

- Pico-SDK
- ESP-IDF
- Arduino
- MicroPython
- CircuitPython



ICM20948

- Pico-SDK
- ESP-IDF
- Arduino
- MicroPython
- CircuitPython



- Arduino
- CircuitPython

VCNL4040



VL53L4CX

- Pico-SDK
- ESP-IDF
- Arduino
- MicroPython
- CircuitPython



BME688

- Pico-SDK
- ESP-IDF
- Arduino
- MicroPython
- CircuitPython

# Command Workflow

- Platform tools install/update
- Boards/Cores set/install
- Project create (optional)
- Libraries import/download/install/add
- Source Code edit/make/compile
- App deploy/copy/upload
- Output monitor

# Pi Directory Structure

\$IOT

```
L /home/$USER/iot  
L ./bin  
L ./arduino  
L ./circuitpython  
L ./esp  
L ./micropython  
L ./pico  
L ./python
```

\$WORK

```
L /home/$USER/iot  
L ./work  
L ./arduino  
L ./circuitpython  
L ./esp-idf  
L ./micropython  
L ./pico
```

# Python Directory Structure

## CIRCUIT

```
L /media/$USER/CIRCUITPY  
L ./code.py  
L ./lib
```

*NOTE: cannot use PyBoard.py*

/dev/ttyACM0

PY\_BOARD=\$IOT/circuitpython/tools/pyboard.py

PY\_BOARD=\$IOT/micropython/tools/pyboard.py

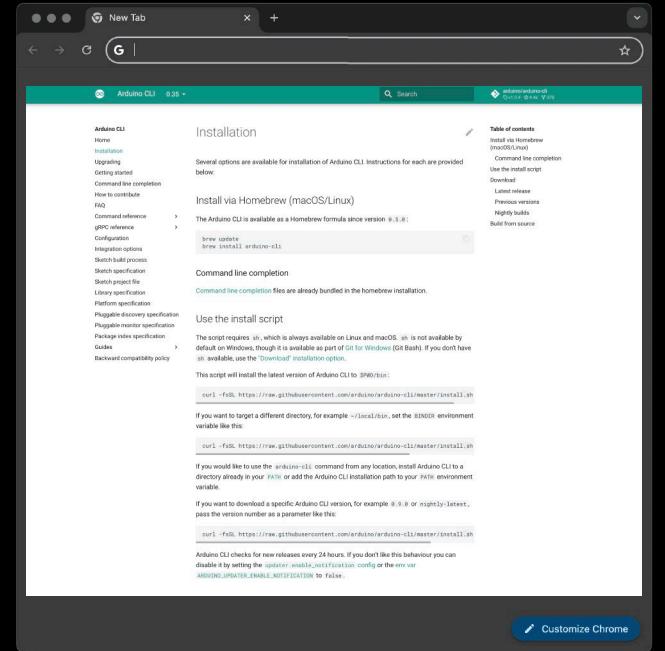
## MICRO

```
/dev/ttyACM0*  
L ./boot.py  
L ./lib
```

*NOTE: must use PyBoard.py*

/dev/ttyACM0

# Arduino - Installation



Google search "arduino cli installation"

<https://arduino.github.io/arduino-cli/1.0/installation/>

```
cd $IOT; mkdir $IOT/arduino; cd ./arduino
```

```
curl -fSSL https://raw.githubusercontent.com/arduino/arduino-cli/master/install.sh | sh
```

*NOTE: This script will install the latest version of Arduino CLI to \$PWD/bin*

# Arduino - Check Status

arduino-cli version

```
git ls-remote --tags https://github.com/  
arduino/arduino-cli | tail -1
```

arduino-cli config dump

arduino-cli core list

arduino-cli lib list

arduino-cli outdated

# Arduino - Update

```
arduino-cli core update-index
```

```
arduino-cli core upgrade
```

```
arduino-cli lib update-index
```

```
arduino-cli lib upgrade
```

```
arduino-cli update
```

```
arduino-cli upgrade
```

```
cd $IOT/arduino
```

```
curl -fsSL https://raw.githubusercontent.com/  
arduino/arduino-cli/master/install.sh | sh
```

*NOTE: This script will install the latest version of Arduino CLI to \$PWD/bin:*



# Arduino - Board Support

```
arduino-cli config add  
board_manager.additional_urls https://  
adafruit.github.io/arduino-board-index/  
package_adafruit_index.json
```

```
arduino-cli core update-index
```

```
arduino-cli board search adafruit | grep samd
```

```
arduino-cli core install adafruit:samd
```

```
arduino-cli board listall samd
```

```
arduino-cli board details -b  
adafruit:samd:adafruit_sht4xtrinkey_m0
```



# Arduino - Create Project

```
cd $WORK/Arduino
```

```
arduino-cli sketch new trinkey_neopixel_blink
```

# Arduino - Edit Code

```
nano $WORK/Arduino/trinkey_neopixel_blink.ino
```



# Arduino - Compile/Upload

```
arduino-cli compile -vu -b  
adafruit:samd:adafruit_sht4xtrinkey_m0 $WORK/  
Arduino/trinkey_neopixel_blink -p /dev/ttyACM0
```

# Arduino - Monitor

```
arduino-cli monitor -p /dev/ttyACM0
```

```
minicom -D /dev/ttyACM0
```



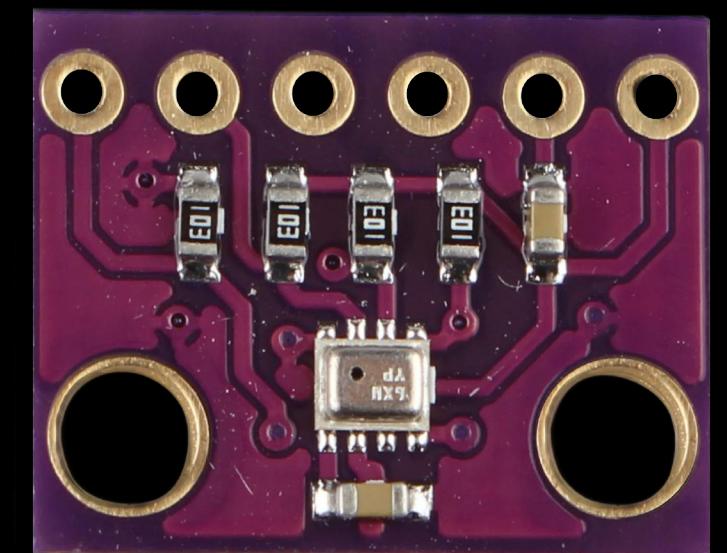
# Arduino - Libraries

**arduino-cli lib list**

**arduino-cli lib search {\$SEARCH}**

**arduino-cli lib download "{\$NAME}"**

**arduino-cli lib install "{\$NAME}"**



BMP280

**arduino-cli lib update-index**

**arduino-cli lib upgrade**

# Arduino - Demo

```
cd $IOT/work/arduino
```

```
ls /dev/serial/*;  
find /sys/bus/usb/devices/usb*/ -name dev | grep tty
```

```
arduino-cli board listall rp2040 | grep "Raspberry Pi"
```

```
cat ./blink/blink.ino
```

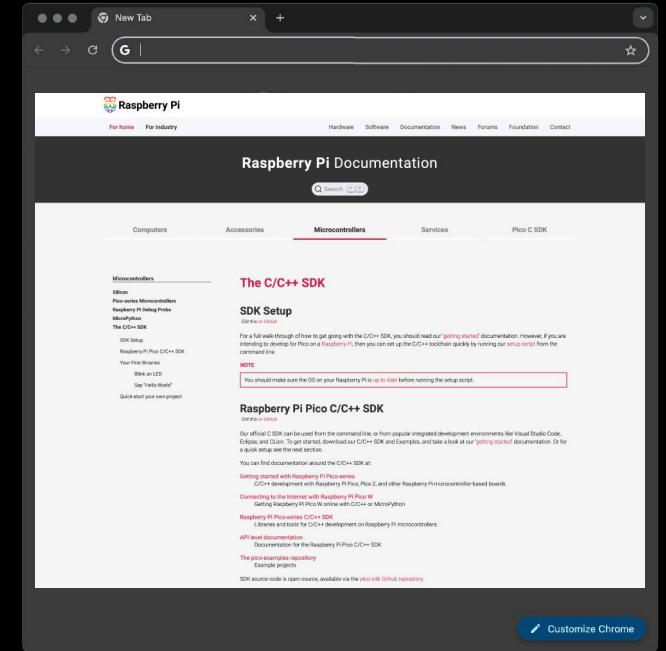
```
arduino-cli compile -vu -b rp2040:rp2040:rpi_pico2  
$IOT/work/arduino/blink -p /dev/ttyACM0
```

```
arduino-cli monitor -p /dev/ttyACM0
```

```
minicom -w -D /dev/ttyACM0
```



# Pico C/C++ SDK - Installation



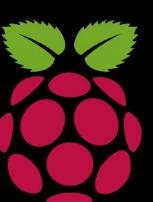
Google search "pico c/c++ sdk"

[https://www.raspberrypi.com/documentation/microcontrollers/c\\_sdk.html](https://www.raspberrypi.com/documentation/microcontrollers/c_sdk.html)

TOOLCHAIN  
`sudo apt install cmake gcc-arm-none-eabi libnewlib-arm-none-eabi build-essential g++ libstdc++-arm-none-eabi-newlib`

`cd $IOT; wget https://raw.githubusercontent.com/raspberrypi/pico-setup/master/pico_setup.sh; chmod +x pico_setup.sh; ./pico_setup.sh`

NOTE: This script will install the latest version of Pick C/C++ SDK to \$IOT/pico



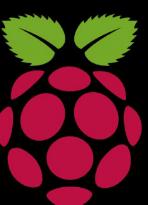
# Pico C/C++ SDK - Check Status

```
which picotool; picotool version;
git ls-remote --tags $(cd $IOT/pico/picotool;
git config --get remote.origin.url) | tail -1

for PICO_REPO in $(ls $IOT/pico/);
do
  cd $IOT/pico/$PICO_REPO;
  git fetch ; git status;
done
```

```
ls $IOT/pico
pico-sdk openocd debugprobe picotool
pico-extras pico-examples pico-playground
```

*NOTE: Repeat for each repository...*



# Pico C/C++ SDK - Update

```
cd $IOT/pico/$PICO-REPO  
git fetch ; git status
```

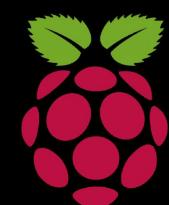
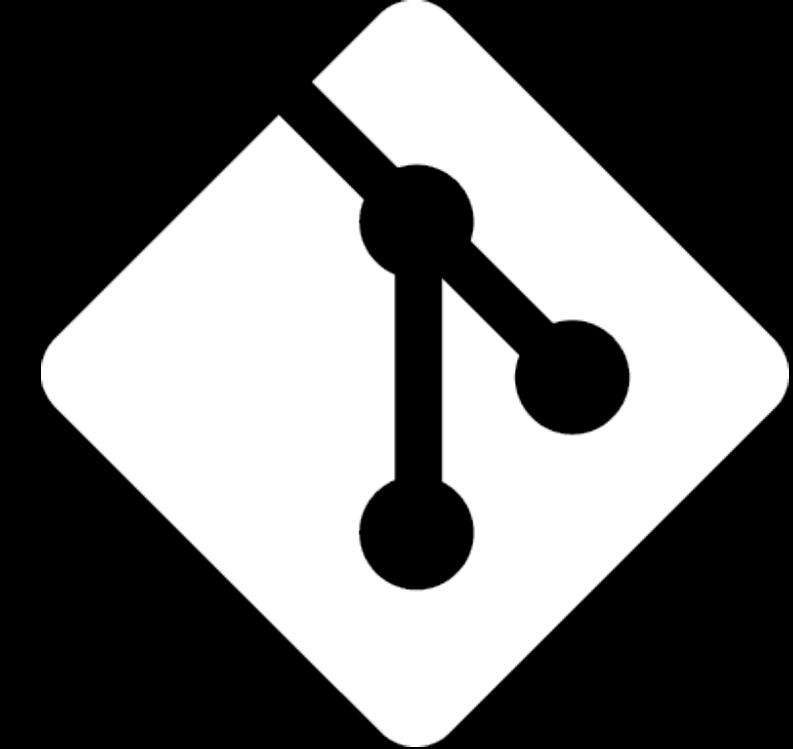
```
git submodule update --recursive --remote  
git restore . --recurse-submodules  
git clean -df -f
```

```
git pull  
git submodule update
```

```
git fetch ; git status
```

```
PICO-REPO=$(ls -d $IOT/pico); echo $PICO-REPO  
pico-sdk openocd debugprobe picotool  
pico-extras pico-examples pico-playground
```

*NOTE: Repeat for each repository...*



# Pico C/C++ SDK - Board Support

```
sudo $IOT/pico/picotool/build/picotool info -a
```

*NOTE: Board must be in USB Drive mode*

```
udevadm info -q all -n /dev/ttyACM0
```

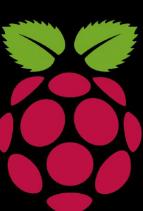
*NOTE: Board must be in BOOTSEL mode*

```
ls $IOT/pico/pico-sdk/src/boards/include/boards/
```

```
adafruit_feather_rp2040.h  
adafruit_feather_rp2040_usb_host.h  
adafruit_itsybitsy_rp2040.h  
adafruit_kb2040.h  
adafruit_macropad_rp2040.h  
adafruit_qtpy_rp2040.h  
adafruit_trinkey_qt2040.h  
pico2.h  
pico.h  
pico_w.h  
pimoroni_badger2040.h  
pimoroni_interstate75.h  
pimoroni_keybow2040.h
```

```
pimoroni_motor2040.h  
pimoroni_pga2040.h  
pimoroni_pga2350.h  
pimoroni_picolipo_16mb.h  
pimoroni_picolipo_4mb.h  
pimoroni_pico_plus2_rp2350.h  
pimoroni_picosystem.h  
pimoroni_plasma2040.h  
pimoroni_plasma2350.h  
pimoroni_servo2040.h  
pimoroni_tiny2040_2mb.h  
pimoroni_tiny2040.h  
pimoroni_tiny2350.h
```

```
seeed_xiao_rp2040.h  
seeed_xiao_rp2350.h  
sparkfun_micromod.h  
sparkfun_promicro.h  
sparkfun_promicro_rp2350.h  
sparkfun_thingplus.h  
switchscience_picossci2ContaBase.h  
switchscience_picossci2DevBoard.h  
switchscience_picossci2Micro.h  
switchscience_picossci2Rp2350Breakout.h  
switchscience_picossci2Tiny.h  
tinycircuits_thumby_color_rp2350.h  
wiznet_w5100s_evb_pico.h
```



# Pico C/C++ SDK - Create Project

```
cd $IOT/work/pico;  
mkdir Helloworld; cd Helloworld
```

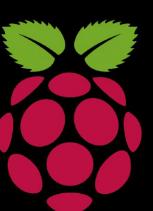
```
touch HelloWorld.c
```

```
touch CMakeLists.txt
```

# Pico C/C++ SDK - Edit Code

```
nano HelloWorld.c
```

```
nano CMakeLists.txt
```



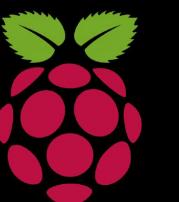
# Pico C/C++ SDK - Compile/Upload

```
rm -rf ./build; mkdir build; cd build  
export PICO_SDK_PATH=$IOT/pico/pico-sdk  
  
cmake -DPICO_BOARD=adafruit_feather_rp2350 ..
```

```
° make -j4 ; ls *.uf2 ; ls /media/$USER  
↳ cp *.uf2 /media/$USER/RP2350/
```

# Pico C/C++ SDK - Monitor

```
minicom -D /dev/ttyACM0
```



# Pico C/C++ SDK - Libraries

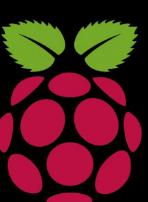
```
ls $IOT/pico/pico-examples/i2c
```

bmp280_i2c	ht16k33_i2c	mcp9808_i2c	mpu6050_i2c	slave_mem_i2c
bus_scan	lcd_1602_i2c	mma8451_i2c	pa1010d_i2c	ssd1306_i2c
CMakeLists.txt	lis3dh_i2c	mpl3115a2_i2c	pcf8523_i2c	

STICKY: Community library list for Pi Pico SDK C/C++

*Topic ID: 305620*

<https://forums.raspberrypi.com/viewtopic.php?t=305620>



# Pico C/C++ SDK - Demo

```
cd $IOT/work/pico/blink
```

```
ls $IOT/pico/pico-sdk/src/boards/include/boards
```

```
picotool info -a -F
```

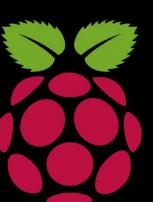
```
cat blink.c
```

```
cat CMakeLists.txt
```

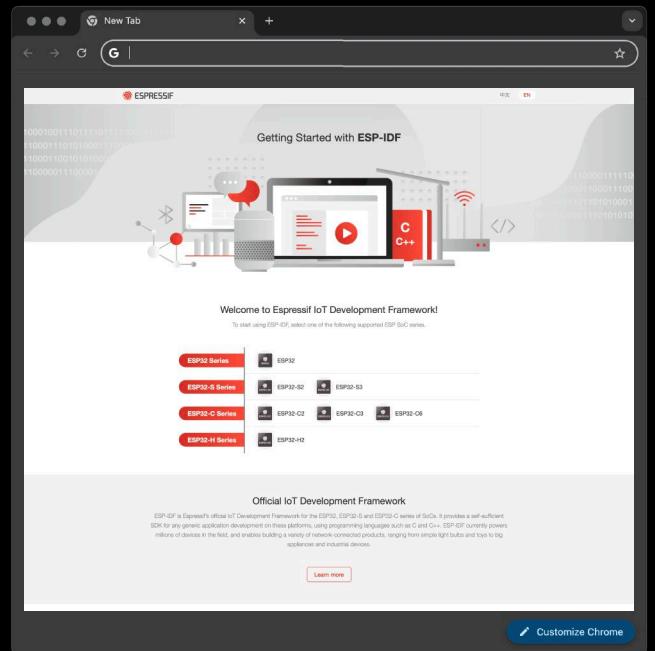
```
rm -rf ./build && mkdir build && cd build && pwd  
cmake -DPICO_BOARD=pico2 -DPICO_PLATFORM=rp2350 ..  
make -j4
```

```
picotool load blink.uf2 -f  
picotool reboot -a
```

```
minicom -w -D /dev/ttyACM0
```



# ESP-IDF - Installation



Google search "esp-idf"

<https://idf.espressif.com/>

**TOOLCHAIN** sudo apt install git wget flex bison gperf python3  
python3-venv cmake ninja-build ccache libffi-dev

mkdir \$IOT/esp && cd \$\_; git clone --recursive  
<https://github.com/espressif/esp-idf.git>

cd \$IOT/esp/esp-idf; ./install.sh

python -m pip install --upgrade esptool --break-  
system-packages



# ESP-IDF - Check Status

```
cd $IOT/esp-idf }  
  . ./export.sh } NOTE: Run Every Time  
To Set Up Environment
```

```
python -m esptool version
```

```
git ls-remote --tags https://github.com/  
espressif/esptool | tail -1
```

```
idf.py --version
```

```
git ls-remote --tags https://github.com/  
espressif/esp-idf | tail -1
```



# ESP-IDF - Update

```
cd $IOT/esp/$ESP-REPO  
git fetch ; git status
```

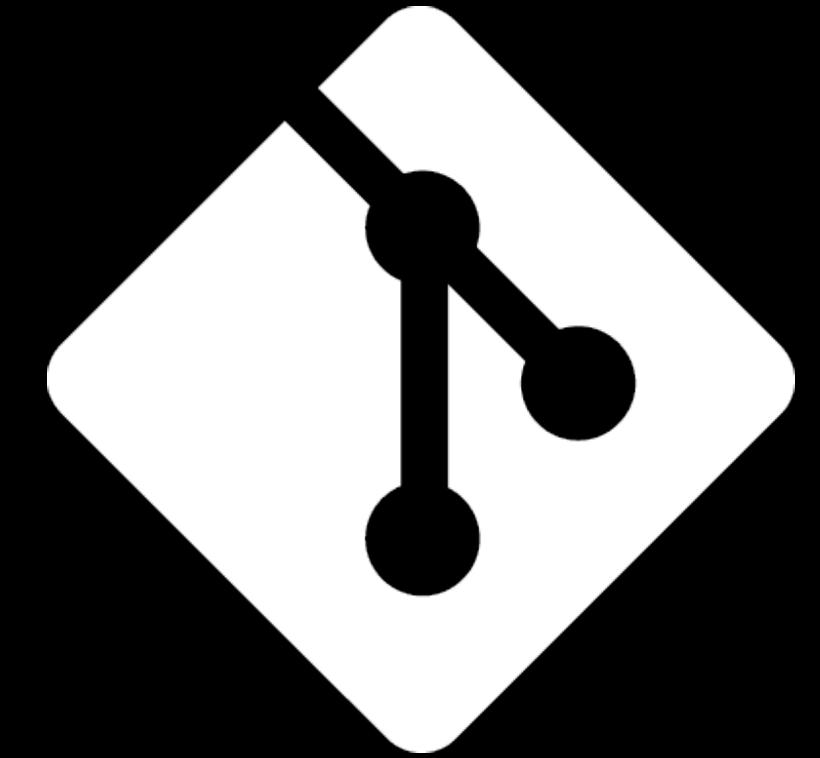
```
git submodule update --recursive --remote  
git restore . --recurse-submodules  
git clean -df -f
```

```
git pull  
git submodule update
```

```
git fetch ; git status
```

```
cd $IOT/esp-idf; ./install.sh
```

```
python -m pip install --upgrade esptool --break-  
system-packages
```



# ESP-IDF - Board Support

```
python -m esptool -p /dev/ttyACM0 chip_id
```

```
idf.py -list-targets
```

```
idf.py set-target esp32s3
```

```
idf.py menuconfig
```



## ESP-IDF - Create Project

```
cd $IOT/work/esp-idf/
```

```
. $IOT/esp-idf/export.sh; idf.py --version
```

```
idf.py create-project blink-led
```

## ESP-IDF - Edit Code

```
nano ./main/blink-led.c
```



# ESP-IDF - Compile/Upload

```
idf.py --list-targets
```

```
idf.py set-target esp32s3
```

```
idf.py menuconfig
```

```
idf.py build
```

```
idf.py /dev/ttyUSB0 flash
```

# ESP-IDF - Monitor

```
idf.py monitor
```

*NOTE: Ctrl-] will exit the monitor*



# ESP-IDF - Libraries



```
cd $IOT/esp; git clone --recursive https://  
github.com/UncleRus/esp-idf-lib.git
```

```
ls $IOT/esp/esp-idf-lib/components
```



# ESP-IDF - Demo

```
cd $IOT/work/esp-idf/blink-led
```

```
ls /dev/serial/* && find /sys/bus/usb/devices/  
usb*/ -name dev | grep tty
```

```
idf.py --list-targets
```

```
python -m esptool -p /dev/ttyACM0 chip_id
```

```
cat ./main/blink-led.c
```

```
cat ./main/CMakeLists.txt
```

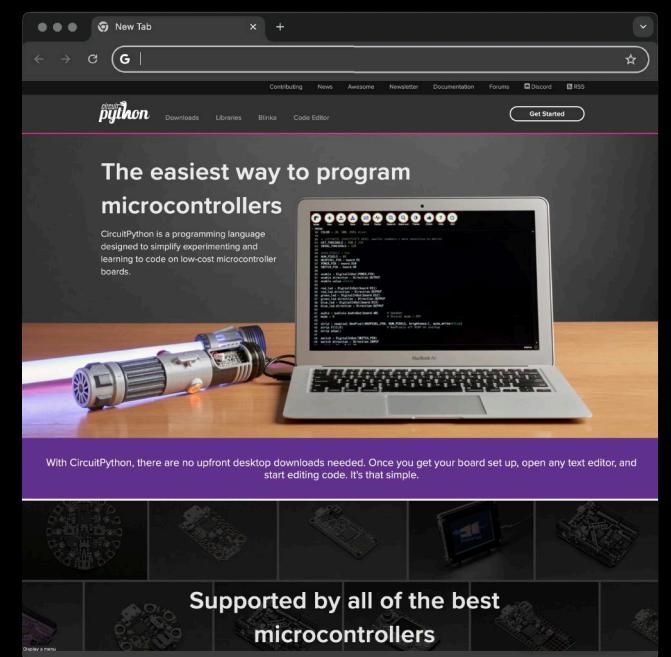
```
idf.py set-target esp32s3
```

```
idf.py build
```

```
idf.py -p /dev/ttyACM0 flash monitor
```



# CircuitPython - Installation



Google search "circuitpython"

<https://circuitpython.org/>

TOOL  
CHAIN

```
sudo apt install build-essential libffi-dev git  
pkg-config cmake gcc-arm-none-eabi  
libnewlib-arm-none-eabi build-essential
```

```
cd $IOT; git clone https://github.com/adafruit/  
circuitpython.git
```

```
python -m pip install --upgrade circup --break-system-  
packages
```



# CircuitPython - Check Status

```
find /sys/bus/usb/devices/usb*/ -name dev | grep tty  
lsblk; ls -laR /media/*; mount | grep media
```

```
IOT_USB_SERIAL=ttyACM0  
sudo ~/iot/pico/picotool/build/picotool info -aF  
python -m esptool -p /dev/$IOT_USB_SERIAL chip_id  
udevadm info -q all -n /dev/$IOT_USB_SERIAL
```

```
minicom -w -D /dev/$IOT_USB_SERIAL  
>>> import board  
>>> dir(board)
```

```
picotool reboot
```

```
python3 $PY_BOARD -c 'print("Hello World")'  
python3 $PY_BOARD -c 'import board; print(dir(board))'
```



# CircuitPython - Check Status

## Pico-SDK

```
/media/ggeoffre/RPI-RP21:  
total 28  
drwxr-xr-x 2 root root 16384 Dec 31 1969 .  
drwxrwxrwx+ 3 root root 4096 Jan 6 18:41 ..  
-r-xr-xr-x 1 root root 241 Sep 5 2008 INDEX.HTM  
-r-xr-xr-x 1 root root 62 Sep 5 2008 INFO_UF2.TXT
```

## CircuitPython

```
/media/ggeoffre/CIRCUITPY:  
total 23  
drwxr-xr-x 5 root root 16384 Dec 31 1969 .  
drwxrwxrwx+ 3 root root 4096 Jan 6 18:51 ..  
-rwxr-xr-x 1 root root 125 Dec 31 1999 boot_out.txt  
-rwxr-xr-x 1 root root 22 Dec 31 1999 code.py  
drwxr-xr-x 2 root root 512 Dec 31 1999 .fsevents  
drwxr-xr-x 2 root root 512 Jan 6 17:14 lib  
-rwxr-xr-x 1 root root 0 Dec 31 1999 .metadata_never_index  
drwxr-xr-x 2 root root 512 Dec 31 1999 sd  
-rwxr-xr-x 1 root root 0 Dec 31 1999 settings.toml  
-rwxr-xr-x 1 root root 0 Dec 31 1999 .Trash-1000  
-rwxr-xr-x 1 root root 0 Dec 31 1999 .Trashes
```

Press and HOLD



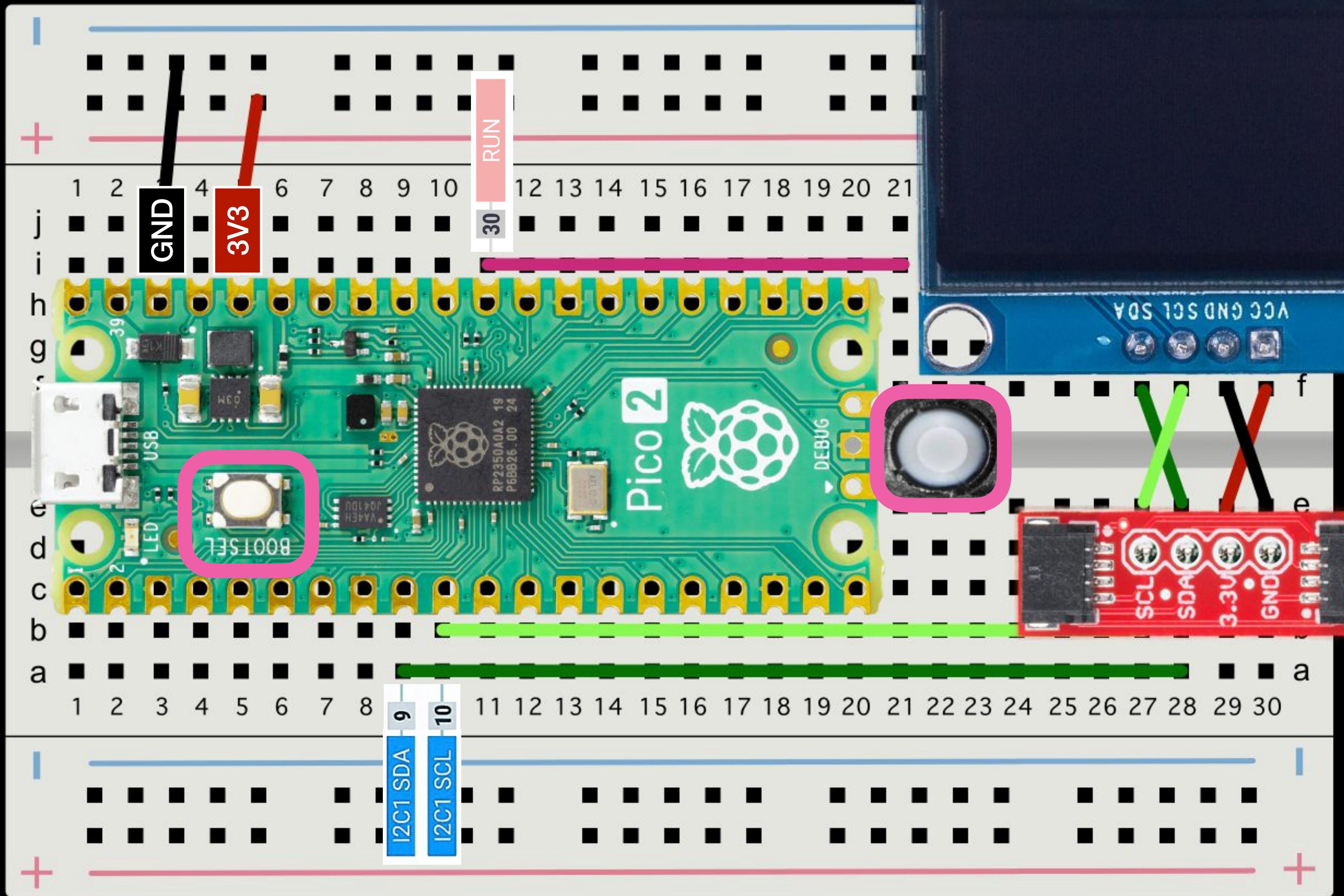
Pull Pin 30 to GND



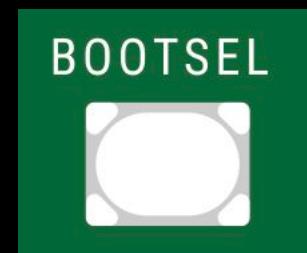
Then RELEASE



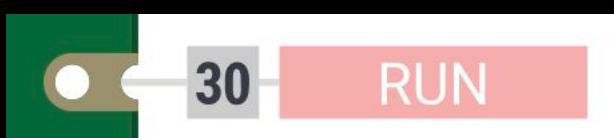
# CircuitPython - Check Status



# Press and HOLD



# Pull Pin 30 to GND



# Then RELEASE



# CircuitPython - Update

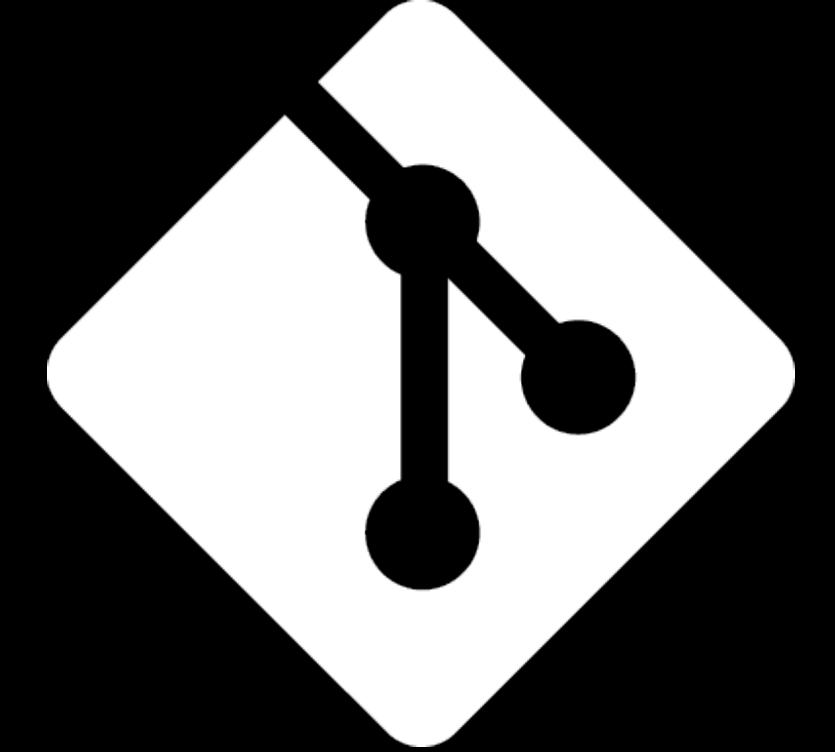
```
cd $IOT/circuitpython  
git fetch ; git status
```

```
git submodule update --recursive --remote  
git restore . --recurse-submodules  
git clean -df -f
```

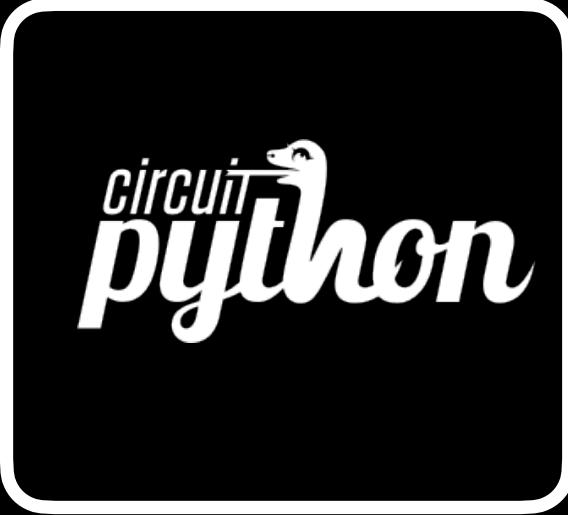
```
git pull  
git submodule update
```

```
git fetch ; git status
```

```
python -m pip install --upgrade circup --break-system-  
packages
```



# CircuitPython - Board Support



<https://circuitpython.org/downloads>

```
wget -q -O - https://circuitpython.org/board/  
raspberry_pi_pico2/ | grep -io '[""]*[^""]*[^""]*' |  
grep org.bin | grep en_US | sort -u | tail -1 | tr -d ''
```

```
wget $(wget -q -O - https://circuitpython.org/board/  
raspberry_pi_pico2/ | grep -io '[""]*[^""]*[^""]*' | grep  
org.bin | grep en_US | sort -u | tail -1 | tr -d '') -P $IOT/bin
```

```
ls -d $IOT/circuitpython/ports/*/boards/**
```

0tspc_space_rp042_esp32c3	m5stack_atom_u	datun_weather	seed_xiao_esp32c3	arduinomkrzero	particle_boron	feather_nrf52840_express	thunderpack_v12	adafruit_micropod_rp2040	microdev_micro_c3	espressif_esp32s3_box_lite	sparkfun_teeny_micromod	challenger_rp2040_lora	piromni_tinyfix
0xcb_gemini	m5stack_cardpuer	denevap_kart	seed_xiao_esp32c6	arduinonano_33_ble	particle_xenon	feather_st32f405_express	tinkeringtech_scoutmakes_azul	adafruit_magtag_2_0_grayscale	microdev_micro_s2	espressif_esp32s3_devtk_i_nt6	sparkfun_thingolies_matter_mgn240p_brd2704a	challenger_rp2040_lite	pitaya_go
0xcb_helios	m5stack_core2	denevap_kart_ta	seed_xiao_esp32_s3_sense	arduinonano_33_ble_rev2	pcat0056	firebeetle2_esp32s3	trellis_m4_express	adafruit_matrixportal_s3	mini_sam_m4	espressif_esp32s3_devtk_i_nt6	sparkfun_thing_plus_rp3940	challenger_rp2040_adrc	pybadge
42keebz_frood	m5stack_core_basic	denevap_kart_te_v2	Seed_XIAO_NRF52840_Sense	arduinonano_33_iot	pcat0059	fliperzero_wifi_dev	trinket_m0	adafruit_metro_exp32s2	mixgo_ce_serial	espressif_esp32s3_devtk_i_nt8	sparkfun_thing_plus_rp2590	challenger_rp2040_subghz	pyb_nano_v2
8080_commander	m5stack_core_fire	denevap_kart_g	sensobox_mcu	arduinonano_esp32c3	pcat0100	fluff_m0	trinket_m0_hexpress	adafruit_metro_exp32s3	mixgo_ce_udisk	espressif_esp32s3_devtk_i_nt8r2	splitkob_lattice	challenger_rp2040_wifi	pyboard_v1i
8080_rp2040_interface	m5stack_cores3	denevap_mini	sensobox_mcu_esp32s2	arduinonano_esp32s3_inverted_statusled	pcat1_wsc_1450	fotu	ttgo_t8_v1_7	adafruit_metro_m7_1011_sd	monster_wsk	espressif_esp32s3_devtk_i_nt8r8	spotbear_esp32s3_lcd_i_44	challenger_rp2040_wifi_ble	pycubed
8080_usb_interposer	m5stack_dial	denevap_mini_v2	serpente	arduinonano_rp2040_connect	pcatpw10	fransininho_wifi_rrom	uartlogger2	adafruit_metro_rp9940	morphane_morpheus-249	espressif_esp32s3_devtk_i_nt8r8_hexkabiket	challenger_rp2358_hexconnect	pycubed_ltran	
adafruit_exp22s2_camera	m5stack_dumper	devkit_xg24_brd26091b	shirty	arduinonano_zero	pcatpw10	fransininho_wifi_rwrover	uchip	adafruit_metro_rp2350	meta_computer	espressif_esp32s3_devtk_i_nt8	scfmi_watchy	challenger_rp2350_wifi_ble5	
adafruit_feather_esp32d_4eflash_noparam	m5stack_stemp_c3	dices_deliight_piuoraa	silognition-m4-shim	arduinonano_d00	pcatpw4	gemma_m0	ugame10	adafruit_nekey_trinkey_m0	muselab_nancop32_s2_wroom	espressif_esp32s3_eye	scsi_isp1807_de_board	circuitalt_zero_s3	pycubed_v05
adafruit_feather_esp32s2	m5stack_stick_c	dotl_esp32_devtk_v1	silognition_rp2040_shim	atmegazebo_esp32s2	picoplatnet	grandcentral_m4_express	ugame22	adafruit_pixel_trinkey_m0	muselab_nancop32_s2_wrover	espressif_esp32s3_lcd_ev	scsi_isp1807_micro_board	circuitebrains_basic_m0	pygame
adafruit_feather_esp32s2_reverse_tft	m5stack_stick_c_plus	dynalora_usb	simml	autosportlabs_esp32_can_x2	pillbug	gravitech_cucumber_m	unexpectedmaker_bling	adafruit_proxlight_trinkey_m0	ndgarage_ndbit6	espressif_esp32s3_lod_ev_v1_5	stackduino_m0_pro	circuitebrains_deluxe_v4	pyportal
adafruit_feather_esp32s2_tft	m5stack_timer_camera_x	dynosat_edu_eps	smartbeedesigns_bee_data_logger	barduino	piromoni_bardger2040	gravitech_cucumber_ms	unexpectedmaker_buzzard_w3	adafruit_qt2840_trinkey	ndgarage_ndbit6_v2	espressif_esp32s3_umb_dig_n8	st0324741fwc_blackpill	circuiteplayground_bluefruit	pyportal_titano
adafruit_feather_esp32s2_4eflash_2mpcam	magiclick_s3_ntv2	dynosat_edu_0bc	smartbeedesigns_bee_motion_s3	bastille	piromoni_bardger2040w	gravitech_cucumber_r	unexpectedmaker_feathers2	adafruit_qtqy_esp32c3	nesopixel_trinkey_m0	espressif_esp6841_devtk_i_02_n4	st0324741fwc_blackpill_with_flash	circuiteplayground_express	pyruler
adafruit_feather_esp32s3_nopram	maker_badge	e_tidget	smartbeedesigns_bee_s3	best_pro_mini_m0	piromoni_inky_frame_5_7	gravitech_cucumber_rs	unexpectedmaker_feathers2_neo	adafruit_qtqy_esp32c2_pico	nfc_copy_cat	espressif_fmi_dewkit_t	st0324741fwc_discovery	circuiteplayground_express_crickit	qtty_m0
adafruit_feather_esp32s3_ntreverse_tft	makerdiary_mxrt1011_nancoit	electrekticks_picoed	snakboard	bdmicro_vina_d5i	piromoni_inky_frame_7_3	hack_club_sprig	unexpectedmaker_feathers2_prelerelease	adafruit_qtqy_esp32c2	nano_nano	espressif_esp32s3_kaluga_i	st0324741fwc_discovery	circuiteplayground_express_displayo	qtty_m0_hexpress
adafruit_feather_esp32s3_nttft	makerdiary_mx60_keyboard	electrolama_minik	solderparty_bbq20kb	bdmicro_vina_d5i_pcba7	piromoni_interstate75	hallowing_m0_express	unexpectedmaker_feathers3	adafruit_qtqy_esp32c3_4eflash_2eboparam	nodemcu_esp32c2	espressif_esp32s3_kaluga_i_13	st0324741fwc_discovery	clue_nrf52840_express	raspberryi_cm4
adafruit_feather_esp32s3_nt2_v2	makerdiary_nf2040_connectkit	electronicsat_bestwifi	solderparty_esp32s4_stamp_x1	beetle-exp2-c3	piromoni_keybow040	hallowing_m0_express	unexpectedmaker_feathers3_neo	adafruit_qtqy_esp32s3_noparam	nucleo_f446re	espressif_esp32s3_kaluga_i_wroom	st0324741fwc_discovery	colubria-del-sensor	raspberryi_cm10
adafruit_feather_huzzah32	makerdiary_nf2040_nt2_devtk	electronut_labs_b1p	solderparty_nf2040_stamp	bless_dev_board_multi_sensor	piromoni_motor2040	harderneutin_oled_d0	unexpectedmaker_nanos3	adafruit_qtqy_rp2040	nucleo_f424gg	espressif_esp32s3_kaluga_i_wrover	stringear_o_expres	cosme_pico	raspberryi_pi4b
adafruit_feather_rp2040	makerdiary_rp2040_ndk	electronut_labs_papyr	solderparty_rp2350_stamp	blm_badge	piromoni_pg9040	helaf_rpicom_v2	unexpectedmaker_omg3	adafruit_quilins_s3_lrpb666	nucleo_f767zi	espruino_banglej2	sunton_sp02_24248912	cp32-4	raspberryi_pi_pico
adafruit_feather_rp2040_adalogger	makerdiary_rp2040_ndk_usb_dongle	esdlink	solderparty_rp2350_stamp_x1	blumicro833	piromoni_pg9250	helatec_nf2040_wifi_lora_v3	unexpectedmaker_pg9250	adafruit_rotary_trinkey_m0	nucleo_h743zi_2	espruino_pico	sunton_sp02_24328904c	cp32_sping_m0	raspberryi_pi_pico2
adafruit_feather_rp2040_can	makerfabs_tft7	escorinabot_makech	sparkfun_luidrive	bluemicro840	piromoni_pgicov_dv_base	heltec_wireless_paper	unexpectedmaker_rgblouch_mini	adafruit_sh4x_trinkey_m0	nulibits_bit_c_pro	espruino_wifi	sunton_sp02_24328908	cp32_sealing_m0_revb	raspberryi_pi_pico2_w
adafruit_feather_rp2040_dvi	makergo_esp32c2_supermini	esp32-erover-dev-cam	sparkfun_micromod_rp2040	boardsource_bloc	piromoni_pgicov_dv_base_w	hexsky_x2	unexpectedmaker_tiny50	adafruit_slide_trinkey_m0	otd_bread_2040	explorerkit_xg24_brd2703a	sunton_sp02_24328902c	cp32_sealing_m0_spiflash	raspberryi_pi_pico_w
adafruit_feather_rp2040_pros_maker	makergo_esp32c2_supermini	expressif_esp32c3_devtk_i_nt4	sparkfun_nf52840_micromod	bpi_bit_s2	piromoni_pgiclop0_6eb	hibot_bluefi	unexpectedmaker_tiny50ico	adafruit_trrs_trinkey_m0	otd_cast_away_rp2040	feather_bluefruit_sense	sunton_sp02_08489898	cerbonetics_ideaboard	raspberryi_zero
adafruit_feather_rp2040_rfim	maple_elite_pi	expressif_esp32c6_devtk_i_nt8	sparkfun_nf52840_mini	bpi_leaf_s0	piromoni_pgiclop0_4eb	hiibot_iots2	unexpectedmaker_tiny50ico_nano	adafruit_vindie_s2	otd_pixelwing_esp32_s2	feather_m0_adalogger	sunton_sp02_084898970	crumpspace_crumps2	raspberryi_zero2w
adafruit_feather_rp2040_scorpion	matrixportal_m4	expressif_esp32c6_devtk_i_nt4	sparkfun_pro_micro_rp2040	bpi_ncico_s3	piromoni_pgicopl0_2	hunterbot_ncf	unexpectedmaker_tiny52	ADM_B_NRF52840_f	otd_rings_feather	feather_m0_basic	superminif_nt52840	cytron_edu_pico_w	raspberryi_zero_w
adafruit_feather_rp2040_thinkink	max32909ekvit	expressif_esp32_devtk_v4_wroom_32e	sparkfun_pro_micro_rp2350	piromoni_pgicopl0_2w	broadlinkstudio_coin_m0	ikigaisense_iota	unexpectedmaker_tiny53	otd_thinker_nt2_nodecu	ohn2020_badge	feather_m0_express	swan_r5	cytron_iriv_i0_controller	raytac_md158q_db-40
adafruit_feather_rp2040_usb_host	melopero_shake_rp2040	expressif_esp32_devtk_v4_wrover	sparkfun_qwiic_micro_no_flash	bradinsenstudio_explorer_rp2040	piromoni_pgicosystem	inxrt101v_evk	unexpectedmaker_tinywatch_s3	ai_thinker_nt2_c3s	openbook_m4	feather_m0_express_crickit	tsayoshiokake_octave_rp2040	cytron_maker_feather_iot_s3	raytac_md158q_rx
adafruit_feather_rp2040_ztc	newbitbit_v12t	expressif_esp32_2eye	sparkfun_qwiic_micro_with_flash	brainbores_neuron	piromoni_plasma2040	inxrt101v_evk	vec_grnd_yd_rp2040	ai_thinker_nt2_c3s-2m	openbook_m7	feather_m0_rf69	targett_module_clip_wroom	cytron_maker_nano_rp2040	renode_cortex_mdplus
adafruit_floppy_rp2040	neowave	expressif_esp32h2_devtk_i_nt4	sparkfun_reedboard_turbo	breadstick_raspberry	piromoni_plasma2040w	inxrt102v_evk	vidi_x	ai_thinker_nt2_c3m	oxcard_artwork	feather_m0_rf69x	targett_module_clip_wrover	cytron_maker_nano_rp2040	rgfru_rp2040
adafruit_fuzzah32_breakout	metro_m4_airlift_lite	expressif_esp32_2lyrat	sparkfun_sd21_dev	boshkey_f1gpi	piromoni_plasma2350	inxrt104v_evk	warmbit_bluepixel	aloriumtech_evo_m01	oxcard_connect	feather_m0_supersized	tenny40	cytron_maker uno_rp2040	robohatmi_nt4
adafruit_itsybitsy_esp32	metro_m4_express	expressif_esp32p4_function_ev	sparkfun_sd21_mini	capablebot_usbhub	piromoni_plasma2350w	inxrt105v_evb	waveshare_esp32s2_pico	apad12690	oxcard_galaxy	feather_m4_can	tenny41	cytron_motion_2350_pro	sam22
adafruit_itsybitsy_esp32	metro_m4_express	expressif_esp32s2_devtk_i_nt4	sparkfun_sd51_micromod	catwan_usbstick	piromoni_servo2040	inxrt1060v_evk	waveshare_esp32_s2_pico_lcd	aramcon2_badge	oxcard_science	feather_m4_express	teknikio_bluebird	datalore_ip_m4	same64_xplained
adafruit_itsybitsy_rp2040	metro_m7_10t1	expressif_esp32s2_devtk_i_nt4r2	sparkfun_sd51_thing_plus	cezerio_evp3206	piromoni_tiny2040	inxrt1060v_evk	waveshare_esp32_s2_ether	aramcon_badge_2019	pfm1200	feather_m7_10t1	TG-Watch	datanoise_pico4d	seededu_no_wio_terminal
adafruit_kb2040	metro_nf52840_express	expressif_esp32s2_devtk_i_nt4r2	sparkfun_sd7146s_micromod	challenger_840	piromoni_tiny2040_2mb	inxrt1070v_evk	itisybitsy_m4_express	waveshare_esp32_s3_geek	archi	pajenico_picopad	feather_mixer_nt101	tinguisse_pendrive_s3	seededu_no_xiao
adafruit_led_glasses_nr52840	microbit_v2	expressif_esp32s3_box	sparkfun_stm32_thing_plus	challenger_nb_rp2040_wifi	piromoni_tiny2350	inxrt1071v_evk	itisybitsy_m4_express	waveshare_esp32_s3_nt28	arduinomkr300	particle_argon	feather_mixernt102	thunderpack_v1i	seededu_no_xiao_kb

# CircuitPython - Demo (board setup)

```
picotool erase -f
```

```
ls /dev/serial/*;  
find /sys/bus/usb/devices/usb*/ -name dev | grep tty  
ls -d $IOT/circuitpython/ports/*/boards/*/* | grep -i pico
```

```
wget -q -O - https://circuitpython.org/board/raspberry_pi_pico2/ |  
grep -io '[ "''''][^"'''"']*[''''']' | grep raspberry_pi_pico2 |  
grep en_US
```

```
wget https://downloads.circuitpython.org/bin/raspberry_pi_pico2/  
en_US/adafruit-circuitpython-raspberry_pi_pico2-en_US-9.2.2.uf2 -P  
$IOT/bin
```

```
picotool load $IOT/bin/adafruit-circuitpython-raspberry_pi_pico2-  
en_US-9.2.2.uf2 -F
```

```
picotool reboot -a
```



## CircuitPython - Edit Code

```
cd $IOT/work/circuitpython/pico  
nano hello_world.py
```

## CircuitPython - Run Code

```
python3 $PY_BOARD hello_world.py
```

## CircuitPython - Upload Code

```
cp hello_world.py /media/$USER/CIRCUITPY/code.py
```

## CircuitPython - Monitor

```
minicom -w -D /dev/ttyACM0
```



# CircuitPython - Demo (run code)

```
PY_BOARD=$IOT/circuitpython/tools/pyboard.py  
python3 $PY_BOARD -c 'print("Hello World")'
```

```
minicom -w -D /dev/ttyACM0  
>>> print("Hello World")
```

```
cd $IOT/work/circuitpython/pico
```

```
cat map_pins.py  
python3 $PY_BOARD map_pins.py
```

```
cat scan_i2c.py  
python3 $PY_BOARD scan_i2c.py
```



# CircuitPython - Libraries

```
cd $IOT/work/circuitpython/pico
```

```
cp /media/$USER/CIRCUITPY/boot_out.txt .
```

```
ls $IOT/work/circuitpython/pico/lib
```

```
circup show
```

```
circup --path . list
```

```
circup --path : update --all
```

```
circup --path : freeze
```

```
circup show
```

```
circup install adafruit_bme280
```



# CircuitPython - Demo (libraries)

## SERIAL

```
ls /dev/serial/*;  
find /sys/bus/usb/devices/usb*/ -name dev | grep tty
```

## STORAGE

```
lsblk | grep -E "sd[a-zA-Z][0-9]";  
ls -laR /media/*
```

## MOUNT

```
sudo mkdir /media/$USER/CIRCUITPY && sudo mount -o  
uid=$USER /dev/$IOT_USB_STORAGE /media/$USER/CIRCUITPY
```

```
circup list && circup show
```

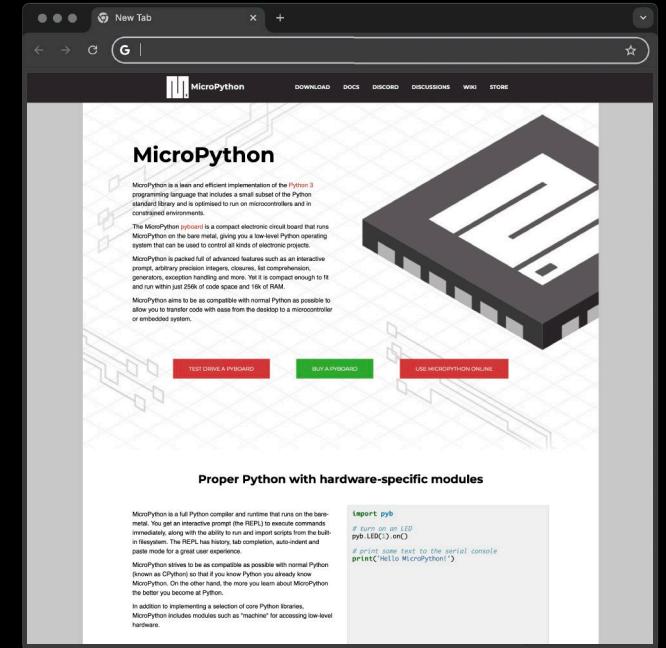
```
circup install adafruit_bme280
```

## UN-MOUNT

```
sudo sync && sudo umount /dev/$IOT_USB_STORAGE && sudo  
rm -r /media/$USER/CIRCUITPY
```



# MicroPython - Installation



Google search "micropython"

<https://micropython.org/>

TOOL  
CHAIN

```
sudo apt install build-essential libffi-dev git  
pkg-config cmake gcc-arm-none-eabi  
libnewlib-arm-none-eabi build-essential
```

```
cd $IOT; git clone https://github.com/micropython/  
micropython.git --branch master
```

```
python -m pip install --upgrade mpremove --break-  
system-packages
```



# MicroPython - Check Status

```
find /sys/bus/usb/devices/usb*/ -name dev | grep tty  
lsblk; ls -laR /media/*; mount | grep media
```

```
IOT_USB_SERIAL=ttyACM0
```

```
sudo ~/iot/pico/picotool/build/picotool info -aF  
python -m esptool -p /dev/$IOT_USB_SERIAL chip_id  
udevadm info -q all -n /dev/$IOT_USB_SERIAL
```

```
minicom -w -D /dev/$IOT_USB_SERIAL
```

```
>>> import machine  
>>> dir(machine.Pin)
```

```
picotool reboot
```

```
python3 $PY_BOARD -c 'print("Hello World")'
```

```
python3 $PY_BOARD -c 'import machine; print(dir(machine.Pin))'
```



# MicroPython - Update

```
cd $IOT/micropython
```

```
git fetch ; git status
```

```
git submodule update --recursive --remote
```

```
git restore . --recurse-submodules
```

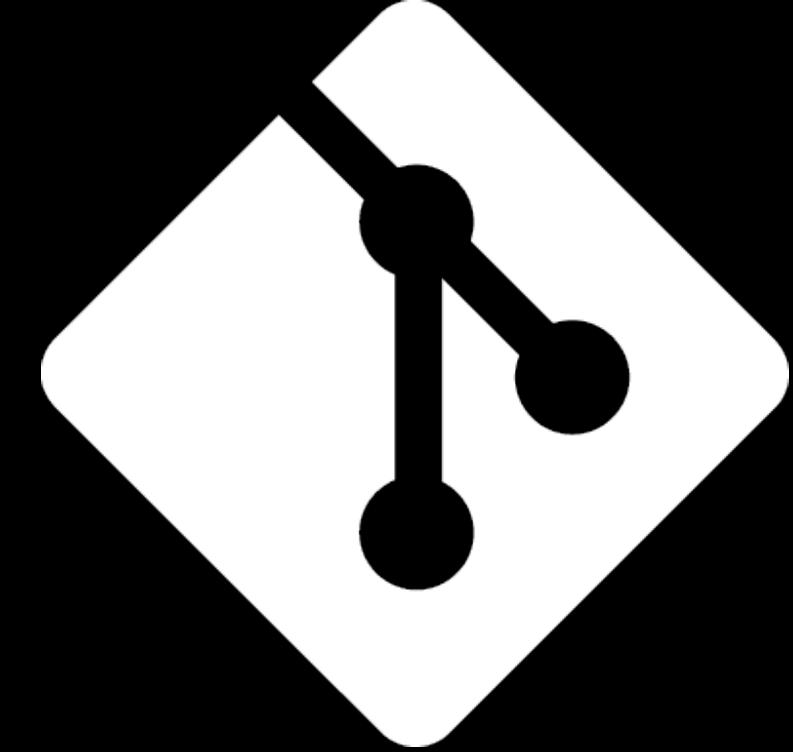
```
git clean -df -f
```

```
git pull
```

```
git submodule update
```

```
git fetch ; git status
```

```
python -m pip install --upgrade mpremote --break-system-packages
```



# MicroPython - Board Support



<https://micropython.org/download/>

```
wget -q -O - https://micropython.org/download/RPI_PICO2/ |  
grep -io '[""]*[^""]*[""]*[""]' | grep firmware | grep  
-Ev "preview" | sort -u | head -2 | tail -1 | tr -d ''
```

```
wget https://micropython.org/$(wget -q -O - https://  
micropython.org/download/RPI_PICO2/ | grep -io '[""]*  
[^""]*[""]*[""]' | grep firmware | grep -Ev "preview" | sort -u  
| head -2 | tail -1 | tr -d '') -P $IOT/bin
```

ls -d \$IOT/micropython/ports/\*/boards/\* /

ACTINIUS_ICARUS	B_L072Z_LRWAN1	IBK_BLYST_NANO	OLIMEX_ESP32_EVB	SEEED_XIAO_NRF52	UM_FEATHERS2NEO
ADAFRUIT_F405_EXPRESS	B_L475E_IOT01A	IDK_BLYST_NANO	OLIMEX_ESP32_POE	SEEED_XIAO_SAMD21	UM_FEATHERS3
ADAFRUIT_FEATHER_M0_EXPRESS	BLUEIO_TAG_EVIM	LAUNCHXL	OLIMEX_H407	SIL_RP2040_SHIM	UM_FEATHERS3NEO
ADAFRUIT_FEATHER_M4_EXPRESS	CERB40	LEGO_HUB_N06	OLIMEX_RT1010	SIL_WESP32	UM_NANOS3
ADAFRUIT_FEATHER_RP2040	common_isr_ram	LEGO_HUB_N07	PARTICLE_XENON	SPARKFUN_MICROMOD_STM32	UM_OMGS3
ADAFRUIT_ITSYBITSY_M0_EXPRESS	common_isr_rom	LILYGO_TTGO_LORA32	PIMORONI_PICOLIPO	SPARKFUN_PROMICRO	UM_PROS3
ADAFRUIT_ITSYBITSY_M4_EXPRESS	DVK_BL652	LIMIFROG	PIMORONI_TINY2040	SPARKFUN_SAMD51_THING_PLUS	UM_RGBTOUCH_MINI
ADAFRUIT_ITSYBITSY_RP2040	ESP32_GENERIC	LOLIN_C3_MINI	POLOLU_3PI_2040_ROBOT	SPARKFUN_THINGPLUS	UM_TINYC6
ADAFRUIT_METRO_M4_EXPRESS	ESP32_GENERIC_C3	LOLIN_S2_MINI	POLOLU_ZUMO_2040_ROBOT	STM32F411DISC	UM_TINYPICO
ADAFRUIT_METRO_M7	ESP32_GENERIC_C6	LOLIN_S2_PICO	PYBLITEV10	STM32F429DISC	UM_TINYS2
ADAFRUIT_QTPY_RP2040	ESP32_GENERIC_S2	M5STACK_ATOM	PYBV10	STM32F439	UM_TINYS3
ADAFRUIT_TRINKET_M0	ESP32_GENERIC_S3	M5STACK_ATOMS3_LITE	PYBV11	STM32F4DISC	UM_TINYWATCHS3
ARDUINO_GIGA	ESP8266_GENERIC	M5STACK_NANOC6	PYBV3	STM32F769DISC	USBDDONGLE_WB55
ARDUINO_NANO_33_BLE_SENSE	ESPRUINO_PICO	MICROBIT	PYBV4	STM32F7DISC	VK_RA6M5
ARDUINO_NANO_ESP32	EVK_NINA_B1	MIKROE_CLICKER2_STM32	RA4M1_CLICKER	STM32H573I_DK	W5100S_EVB_PICO
ARDUINO_NANO_RP2040_CONNECT	EVK_NINA_B3	MIKROE_QUAIL	RPI_PICO	STM32H7B3I_DK	W5500_EVB_PICO
ARDUINO_NICLA_VISION	FEATHER52	MINISAM_M4	RPI_PICO2	STM32L476DISC	WEACTSTUDIO
ARDUINO_OPTA	GARATRONIC_NADHAT_F405	NETDUINO_PLUS_2	RPI_PICO_W	STM32L496GDISC	WIPY
ARDUINO_PORTENTA_C33	GARATRONIC_PYBSTICK26_F411	NRF52840_MDK_USB_DONGLE	SAMD21_XPLAINED_PRO	TEENSY40	WT51822_S4AT
ARDUINO_PORTENTA_H7	GARATRONIC_PYBSTICK26_RP2040	NULLBITS_BIT_C_PRO	SEEED_ARCH_MIX	TEENSY41	UM_FEATHERS2
ARDUINO_PRIMO	HYDRABUS	OLIMEX_E407	SEEED_WIO_TERMINAL		

# MicroPython - Demo (board setup)

```
picotool erase -f
```

```
ls /dev/serial/*;  
find /sys/bus/usb/devices/usb*/ -name dev | grep tty  
ls -d $IOT/micropython/ports/*/boards/*/ | grep -i rpi
```

```
wget -q -O - https://micropython.org/download/RPI_PICO2/ |  
grep -io '[""]*[^""]*[""]*[^""]*' | grep firmware | grep -Ev  
"preview" | sort -u | tail -1 | tr -d ''
```

```
wget https://micropython.org/resources/firmware/  
RPI_PICO2-20241129-v1.24.1.uf2 -P $IOT/bin
```

```
picotool load $IOT/bin/RPI_PICO2-20241129-v1.24.1.uf2 -F
```

```
picotool reboot -a
```



## MicroPython - Edit Code

```
cd $IOT/work/micropython/pico  
nano hello_world.py
```

## MicroPython - Run Code

```
python3 $PY_BOARD hello_world.py
```

## MicroPython - Upload Code

```
cp hello_world.py /media/$USER/MICROPY/code.py
```

## MicroPython - Monitor

```
minicom -w -D /dev/ttyACM0
```



# MicroPython - Demo (run code)

```
PY_BOARD=$IOT/micropython/tools/pyboard.py  
python3 $PY_BOARD -c 'print("Hello World")'
```

```
minicom -w -D /dev/ttyACM0  
>>> print("Hello World")
```

```
cd $IOT/work/micropython/pico
```

```
cat map_pins.py  
python3 $PY_BOARD map_pins.py
```

```
cat scan_i2c.py  
python3 $PY_BOARD scan_i2c.py
```

