Edge TPU Coral Dev Board: A tutorial

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Edition: May 13, 2019

Outline

❑Introduction and specification

❑Required Hardware and tools

❑Flash the board

❑Run a model

Coral Dev Board
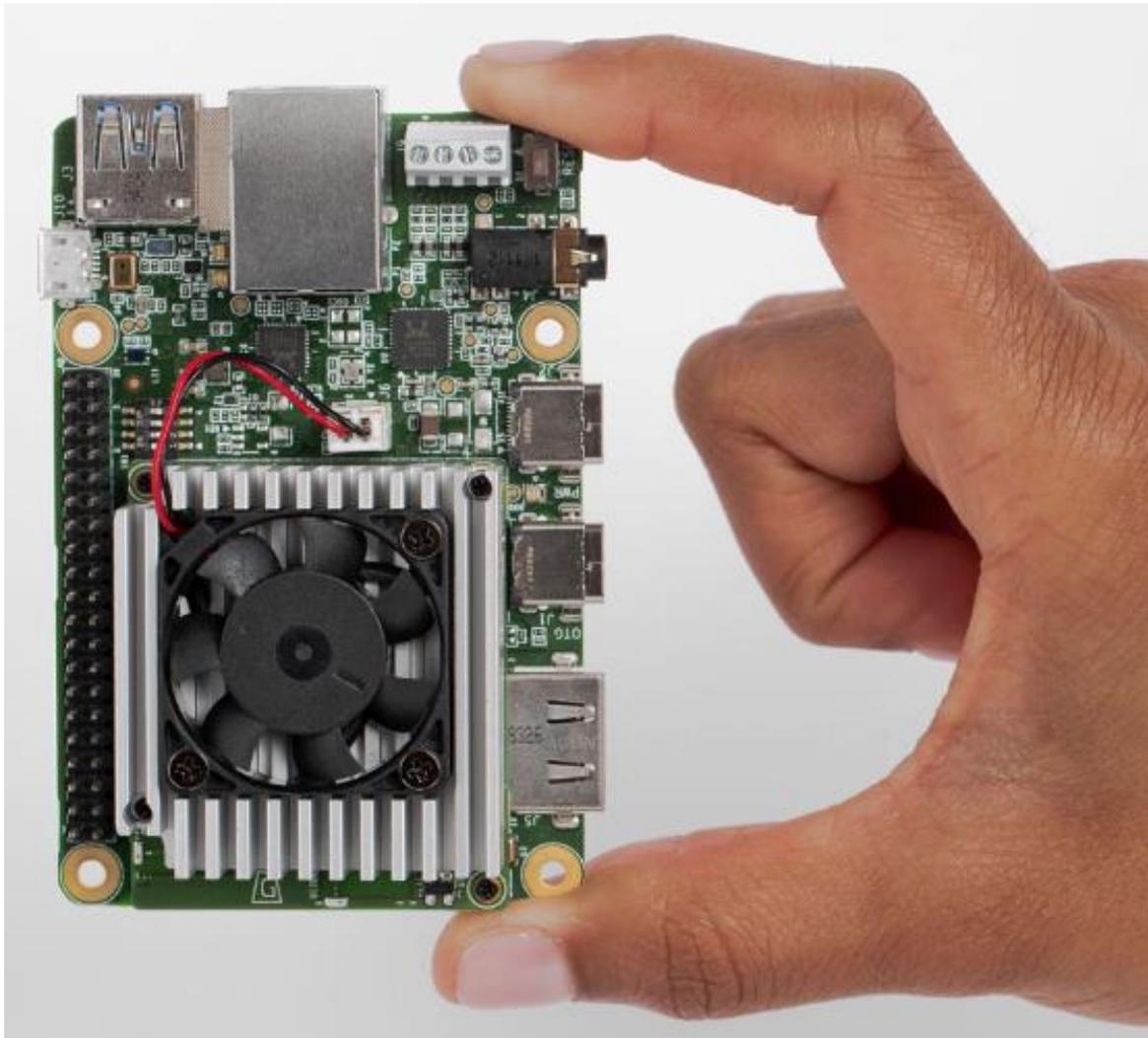
❑ The Coral Dev Board is a single-board computer with a removable system-on-module (SOM) that contains eMMC, SOC, wireless radios, and the Edge TPU.

❑ Accelerated ML; prototype internet-of-things (IOT) devices; embedded systems that demand fast on-device ML inferencing.

Board's Features (1/2)

85 mm

56 mm
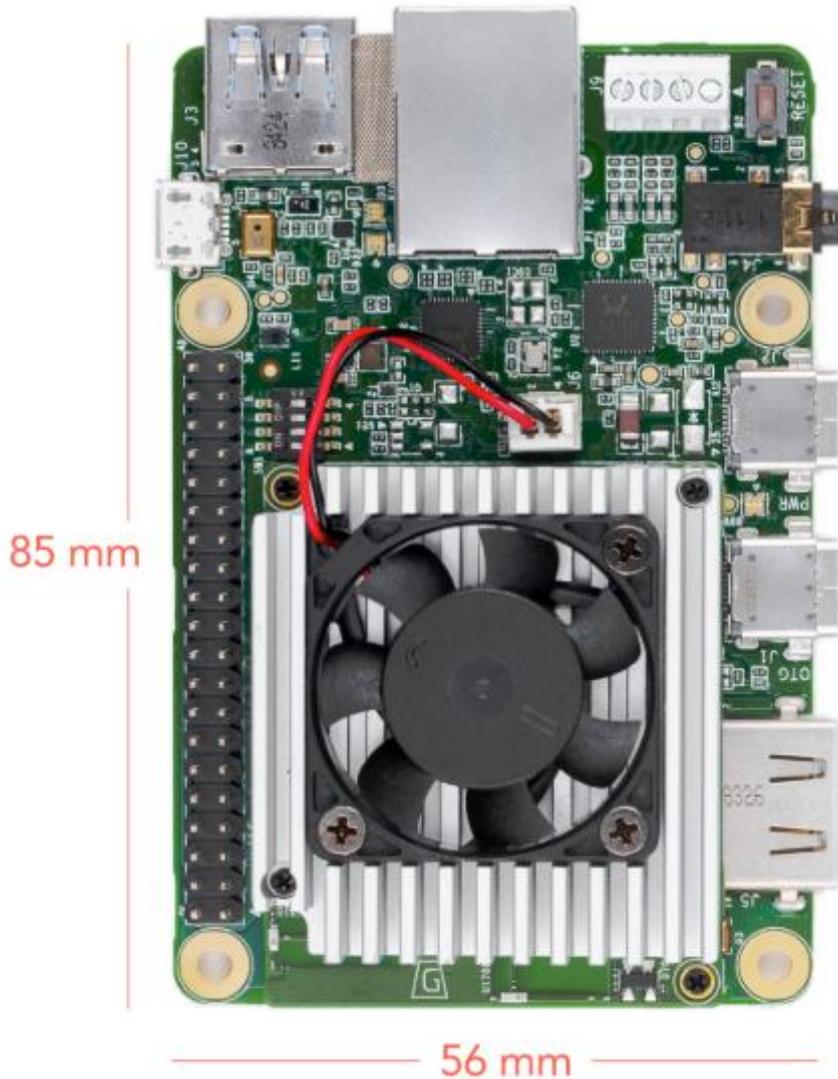
❑ **Edge TPU Module (SOM)**
- NXP i.MX 8M SOC (Quad-core Cortex-A53, plus Cortex-M4F)
- Google Edge TPU ML accelerator coprocessor
- Cryptographic coprocessor
- Wi-Fi 2x2 MIMO (802.11b/g/n/ac 2.4/5GHz)
- Bluetooth 4.1
- 8GB eMMC
- 1GB LPDDR4

Board's Features (2/2)
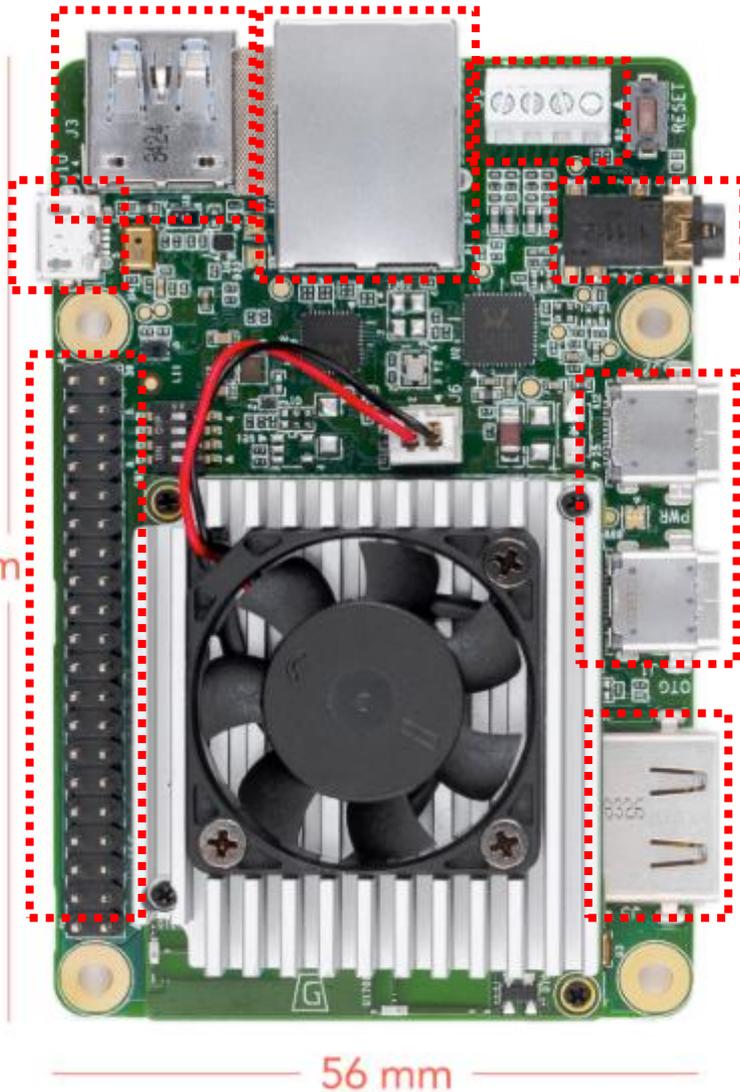
- ❑ **USB connections**
  - USB Type-C power port (5V DC)
  - USB 3.0 Type-C OTG port
  - USB 3.0 Type-A host port
  - USB 2.0 Micro-B serial console port
- ❑ **Audio connections**
  - 3.5mm audio jack (CTIA compliant)
  - Digital PDM microphone (x2)
  - 2.54mm 4-pin terminal for stereo speakers
- ❑ **Video connections**
  - HDMI 2.0a (full size)
  - 39-pin FFC connector for MIPI DSI display (4-lane)
  - 24-pin FFC connector for MIPI CSI-2 camera (4-lane)
- ❑ **MicroSD card slot**
- ❑ **Gigabit Ethernet port**
- ❑ **40-pin GPIO expansion header**
- ❑ **Supports Mendel Linux (derivative of Debian), Tensorflow Lite**

Hardware and tools

❑ **Required hardware:**

- Linux or Mac computer (referred to below as "host computer")
- USB-A to USB-microB cable (to connect your PC to the board's serial port)
- USB-A to USB-C cable (to connect your PC to the board's data port)
- 2 - 3A (5V) USB Type-C power supply (such as a phone charger)
- Ethernet cable or Wi-Fi connection

Hardware and tools

❑**Tools:**

- A serial console program: such as ***screen***, ***picocom***, or ***PuTTY*** (among many others), installed on host computer.

```
sudo apt-get install screen
```

- The latest ***fastboot*** tool.
  - Download Android SDK Platform-tools
  - Install:

```
mkdir -p ~/.local/bin

sudo mv ~/Downloads/platform-tools/fastboot ~/.local/bin/
```

  - Verify:

```
fastboot --version
```

Flash the board (1/8)

❑Step 1: Switch to eMMC boot mode

- The board is completely unplugged (not powered and not connected to your computer).
- The boot mode switches are set to eMMC mode:

Boot mode	Switch 1	Switch 2	Switch 3	Switch 4
eMMC	ON	OFF	OFF	OFF
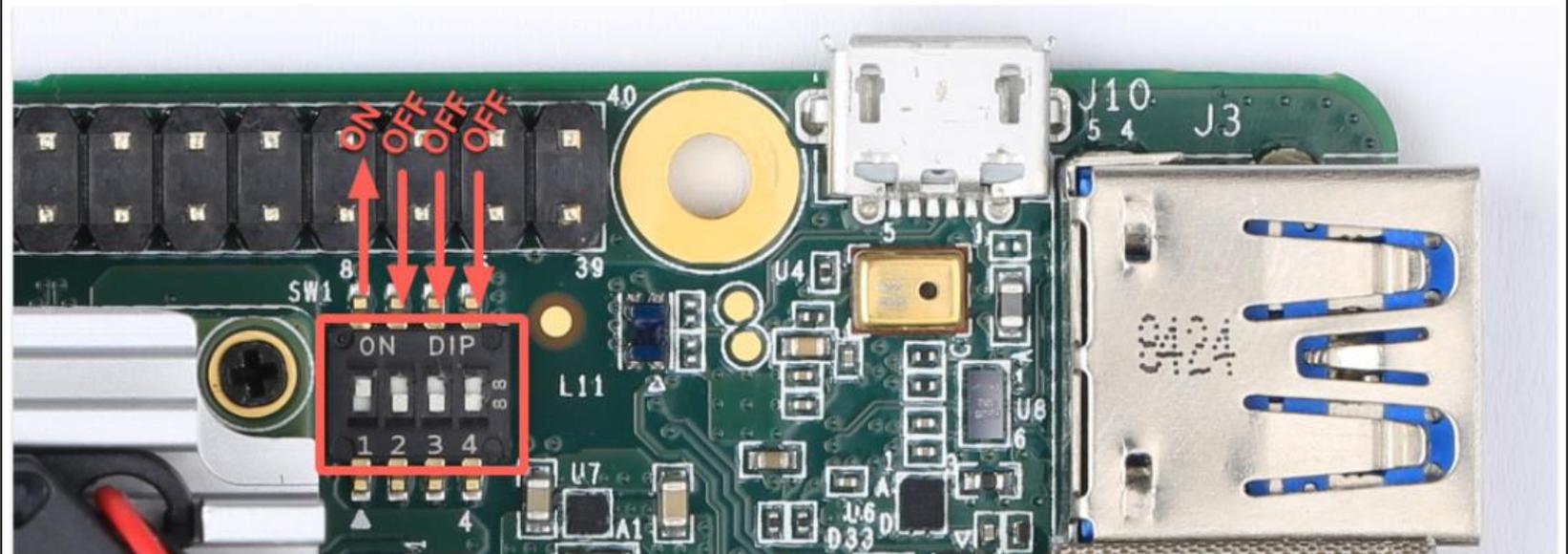
Flash the board (2/8)

❑Step 2: Install the udev rule or driver on your host computer.

- This is required to communicate with the Dev Board over the serial console.

- *On Linux:*

```
sudo sh -c "echo 'SUBSYSTEM==\"usb\", ATTR{idVendor}==\"0525\", MODE=\"0664\", \
GROUP=\"plugdev\", TAG+=\"uaccess\"' >> /etc/udev/rules.d/65-edgetpu-board.rules"

sudo udevadm control --reload-rules && udevadm trigger
```

- *On Mac: Install the CP210x USB to UART Bridge Virtual COM Port (VCP) driver for Mac.*

❑**Step 3: Connect to the serial console.**

- USB-microB: host computer => to the serial console port on the board. The orange and green LEDs on the board should illuminate.
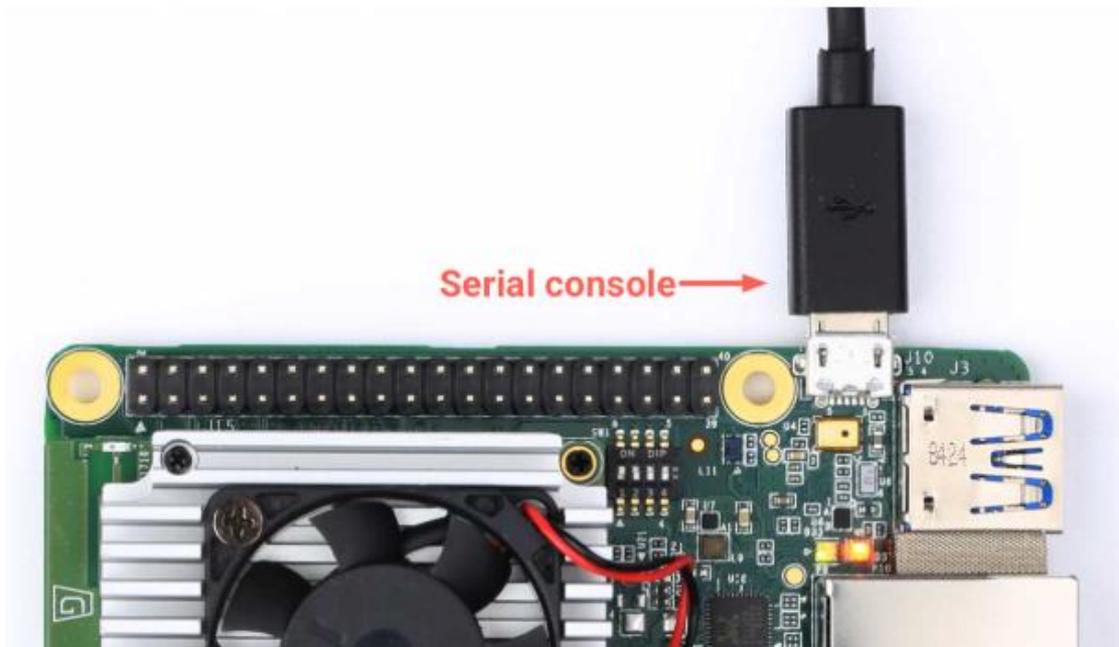
Flash the board (4/8)

□ **Step 3: Connect to the serial console.**

- ▪ *On Linux:*
  - • Determine the device filename

  ```
  dmesg | grep ttyUSB
  ```

  - • You should see two results such as this:

  ```
  [ 6437.706335] usb 2-13.1: cp210x converter now attached to ttyUSB0
  [ 6437.708049] usb 2-13.1: cp210x converter now attached to ttyUSB1
  ```

  - • Then use the name of the first filename listed as a cp210x converter to open the serial console connection

  ```
  screen /dev/ttyUSB0 115200
  ```

- ▪ *On Mac:*

  ```
  screen /dev/cu.SLAB_USBtoUART 115200
  ```

❑Step 4: Power the board.

- Plug in your 2 - 3A power cable to the USB-C port labeled "PWR".
- Your serial console (the *screen* terminal) should arrive at the u-boot prompt. You should see a *"Welcome"* message
- Caution: Do not attempt to power the board by connecting it to your computer.
- Help! If you still don't see anything in the serial console screen, press Enter.
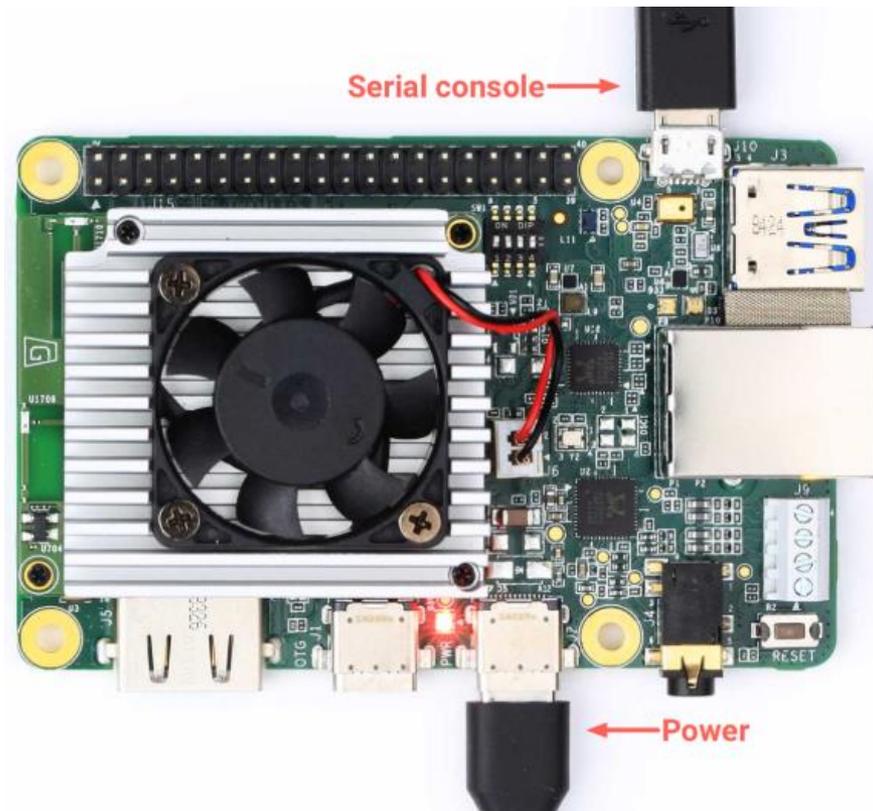
Flash the board (6/8)

☐ **Step 5: Start *fastboot*.**

- In your serial console's u-boot prompt, execute the following:

```
fastboot 0
```

- The cursor should simply move to the next line. *Fastboot* is now waiting for the host to begin flashing a system image.

Step 6: Connect to *fastboot* over USB.

- Use your USB-C cable to connect your host computer to the USB-C data port labeled "OTG" on the Dev Board.
- On host, open a new terminal

```
fastboot devices
```

- You should see a line printed like this:

```
1b0741d6f0609912        fastboot
```
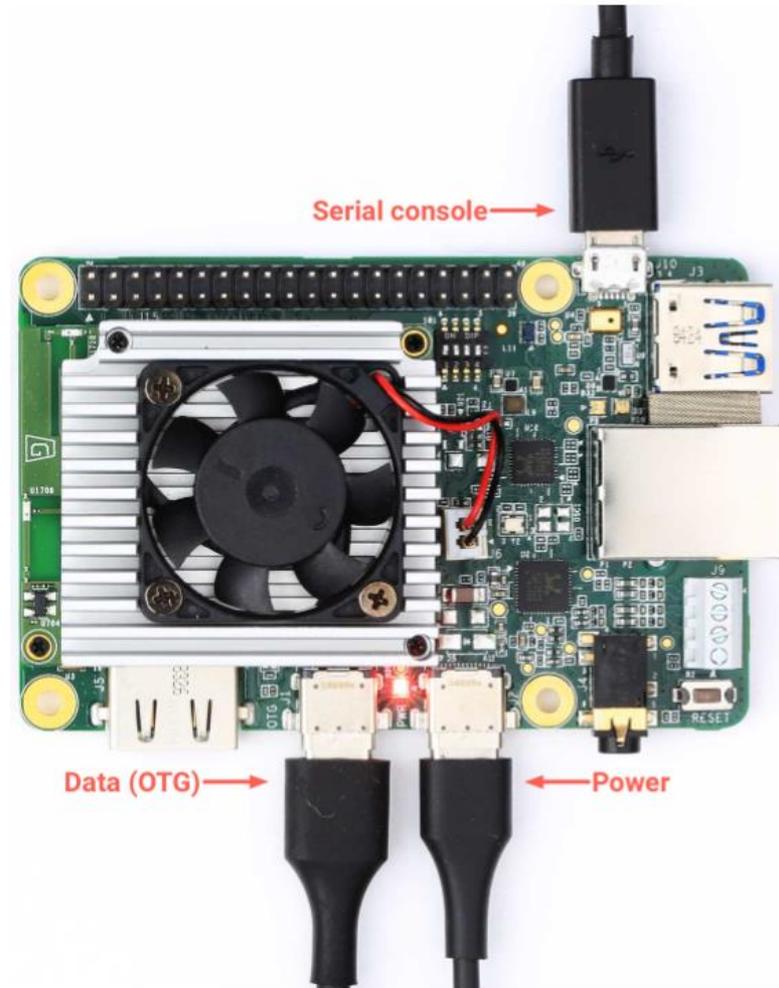
Flash the board (8/8)

☐ Step 7: Download and flash the system image.

- On host:

```
cd ~/Downloads

curl -O https://dl.google.com/coral/mendel/enterprise/mendel-enterprise-chef-13.zip

unzip mendel-enterprise-chef-13.zip \
&& cd mendel-enterprise-chef-13

bash flash.sh
```

- This starts the flashing process and you'll see various output.

❑Step 8: Login

- Switch back to the serial console to observe the flashing progress. It takes about 5 minutes to complete. When it's done, the system reboots and the console prompts you to login.

Login is `mendel`
Password is `mendel`

Mendel Development Tool: Install

❑MDT is a command line tool that helps you perform tasks with connected Mendel devices, such as this Dev Board. For example, MDT can list connected devices, install Debian packages on a device, open a shell with a device, and more. And you'll need it in the next section to generate SSH keys.

❑Install:

```
pip3 install --user mendel-development-tool
```

- ▪ Note:
  - • The *--user* flag installs the mdt executable in your user directory.
  - • On Linux, that's ~/.local/bin/.
  - • On a Mac, it's something like /Users/yourname/Library/Python/3.7/bin/.
  - • If you remove that flag, it requires root access and will install at /usr/local/bin. So make sure that the appropriate path is in your PATH environment variable.

Mendel Development Tool: Connect

❑ Using the serial console was necessary only to enable fastboot. Now that you have the Mendel system on the board, you can unplug the microB USB cable and open a shell using MDT over the USB-C cable (see figure 5).

❑ Using MDT is just an easy way to generate an OpenSSH public/private key pair, push the public key onto the board, and then establish an SSH connection.

❑ To open the shell, run this command on your host computer:

Data (OTG) ⟶   ⟵ Power

```
mdt shell
```
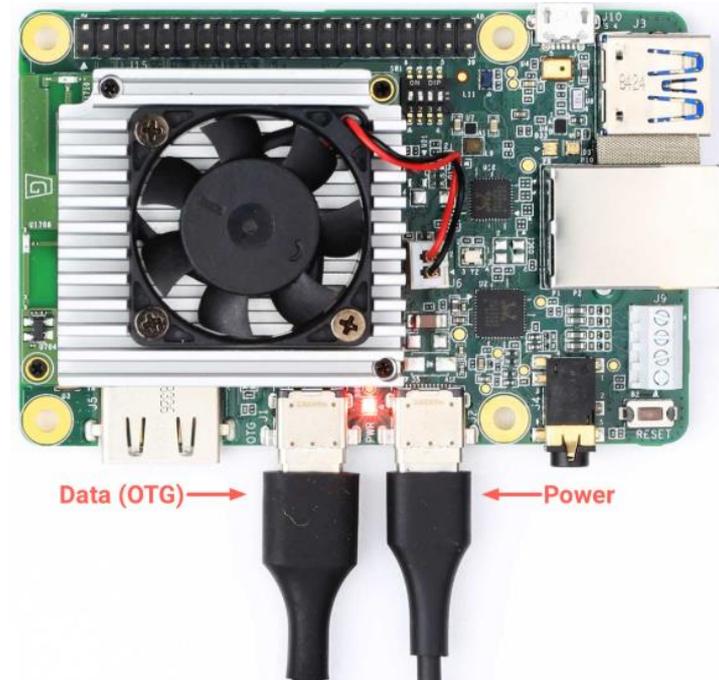
Run a model: demo

❑ On your desktop:
- For a video demo of the Edge TPU performance, run the following command from the Dev Board terminal:

```
edgetpu_demo --stream
```

- Then on your desktop (that's connected to the Dev Board)—if you're connected to the board using ssh over USB—open 192.168.100.2:4664 in a browser. If you're instead connected to the board by other means (such as SSH over LAN or with an Ethernet cable), type the appropriate IP address into your browser with port 4664.

❑ Or if you have a monitor attached to the Dev Board, you can instead see the demo on that screen:

```
edgetpu_demo --device
```

Reference

[Google2019] Get started with the Dev Board, website: https://coral.withgoogle.com/docs/dev-board/get-started/, access date: May 10, 2019.