

# Install TensorFlow for CPU and EdgeTPU

Google's TensorFlow is currently the most popular python library for Deep Learning. It can be used for image recognition, face detection, natural language processing, and many other applications. There are two methods to install TensorFlow on Raspberry Pi:

- TensorFlow for CPU
- TensorFlow for Edge TPU Co-Processor (the \$75 Coral branded USB stick)

## Install TensorFlow for CPU

The first method installs the CPU version of TensorFlow. We will NOT use Pi to perform any deep learning (i.e. model training), as its CPU is vastly insufficient for backward propagation, a very slow operation required in the learning process. However, we can use the CPU to do inferences based on a pre-trained model. Inference is also known as model prediction, which uses only forward propagation, a much faster computer operation. Even with the CPU just doing inference, it can only do so on a relatively shallow model (say 20–30 layers) in real time. For deeper models (100+ layers), we would need the Edge TPU. As of May 2019, the most recent production version of TensorFlow is version 1.13 (2.0 is still alpha)

```
pi@raspberrypi:~ $ pip3 install tensorflow
Collecting tensorflow
[omitted...]
pi@raspberrypi:~ $ pip3 install keras
Collecting keras
[omitted...]
Successfully installed h5py-2.9.0 keras-2.2.4 keras-applications-1.0.7 keras-
preprocessing-1.0.9 numpy-1.16.3 pyyaml-5.1 scipy-1.2.1 six-1.12.0
```

Now let's test and make sure the installation went fine. When you import TensorFlow, it will report some warning messages. But they can be safely ignored. You should not see any errors. (If you do see other errors, please post the commands you typed and the error message in the post down below, and I will try to help.)

```
pi@raspberrypi:~ $ python3
Python 3.5.3 (default, Sep 27 2018, 17:25:39)
[GCC 6.3.0 20170516] on linux
Type "help", "copyright", "credits" or "license" for more information.
```

```
>>> import numpy
>>> import cv2
>>> import tensorflow
/usr/lib/python3.5/importlib/_bootstrap.py:222: RuntimeWarning: compiletime
version 3.4 of module 'tensorflow.python.framework.fast_tensor_util' does not match
runtime version 3.5
return f(*args, **kwargs)
/usr/lib/python3.5/importlib/_bootstrap.py:222: RuntimeWarning: builtins.type size
changed, may indicate binary incompatibility. Expected 432, got 412
return f(*args, **kwargs)
>>> import keras
Using TensorFlow backend.
>>> quit()
```

## Install TensorFlow for EdgeTPU

All you need to do is download the Edge TPU runtime and the TensorFlow Lite library (or edgetpu module) on the computer where you'll connect the USB Accelerator (Raspberry Pi).

When the deep learning models are very deep, 100 layers or more, to achieve real-time performance, it needs to run on the EdgeTPU coprocessor instead of the CPU. However, at the time of writing, Edge TPU is so new (release to the general public around early 2019) that it cannot run all models that can run on the CPU, so we have to choose our model architecture carefully and make sure they will work on EdgeTPU. For more details on what models can run on Edge TPU, please read [this article by Google](#).

Follow the [instructions](#) below to install TensorFlow for EdgeTPU.

```
# Install the Edge TPU runtime
pi@raspberrypi:~ $ echo "deb https://packages.cloud.google.com/apt coral-edgetpu-
stable main" | sudo tee /etc/apt/sources.list.d/coral-edgetpu.list

pi@raspberrypi:~ $ curl https://packages.cloud.google.com/apt/doc/apt-key.gpg |
sudo apt-key add -

pi@raspberrypi:~ $ sudo apt-get update

pi@raspberrypi:~ $ sudo apt-get install libedgetpu1-max

# Install the Edge TPU library (the edgetpu module)
pi@raspberrypi:~ $ sudo apt-get install python3-edgetpu
```

Let's try to test it by running a live object detection program. We will run a demo object detection app from the DeepPiCar repo.

```
pi@raspberrypi:~ $ cd ~/DeepPiCar/models/object_detection/
pi@raspberrypi:~/DeepPiCar/models/object_detection $ python3
code/coco_object_detection.py
W0420 12:36:55.728087 7001 package_registry.cc:65] Minimum runtime version
required by package (5) is lower than expected (10).
couch, 93% [[ 4.81752396 167.15803146]
[381.77787781 475.49484253]] 113.52ms
book, 66% [[456.68899536 145.12086868]
[468.8772583 212.99516678]] 113.52ms
book, 58% [[510.65818787 229.35571671]
[534.6181488 296.00133896]] 113.52ms
book, 58% [[444.65190887 222.51708984]
[467.33409882 290.39138794]] 113.52ms
book, 58% [[523.65917206 142.07738876]
[535.19741058 213.77527237]] 113.52ms
-----
2019-04-20 12:36:57.025142: 7.97 FPS, 125.46ms total, 113.52ms in tf
```

You should see a live video screen coming up, and it will try to identify objects in the screen at around 7–8 Frames/sec. Note that the [COCO \(Common Object in COntext\) object detection model](#) can detect about 100 common objects, like a person, chair, TV, couch, book, laptop, cell phone, etc. Don't let this simple program fool you, this is **Deep Learning** at work. The object detection model used in this program is called [ssd\\_mobilenet\\_coco\\_v2](#), and it contains more than 200 layers! (For comparison, I have tried earlier to run the COCO object detection model with Pi's CPU, it was a much longer set up, can only run at 1 Frame/sec, CPU's utilization is 100%, and CPU temperature heats up very quickly. So running deep models on CPU is not recommended.) Of course, this is just a demo app that confirms that Edge TPU is set up correctly. We will exploit Edge TPU's full capabilities in Part 6 of this series, [Real-Time Traffic Sign and Pedestrian Detection and Handling](#).

