Introduction to Tensorflow

CMPT 498/898 Deep Learning and Applications

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TensorFlow (v1.x)

TensorFlow is an interface for expressing machine learning algorithms, and an implementation for executing such algorithms (Abadi et al., 2015).

- Represents computations as graphs.
  - Nodes in the graph are called ops
  - Edges are tensors
- Represents data as tensors.
  - A tensor is an n-dimensional array with a rank, shape and type.
  - For example $[\text{batch}, \text{height}, \text{width}, \text{channels}]$
- Executes graphs in the context of sessions.
  - A session places the graph ops onto devices such as CPUs/GPUs etc.
- Maintains state with variables.
  - Typically represent the parameters of a statistical model as a set of variables
- Uses feeds and fetches to get data into and out of arbitrary operations.

Abstraction levels

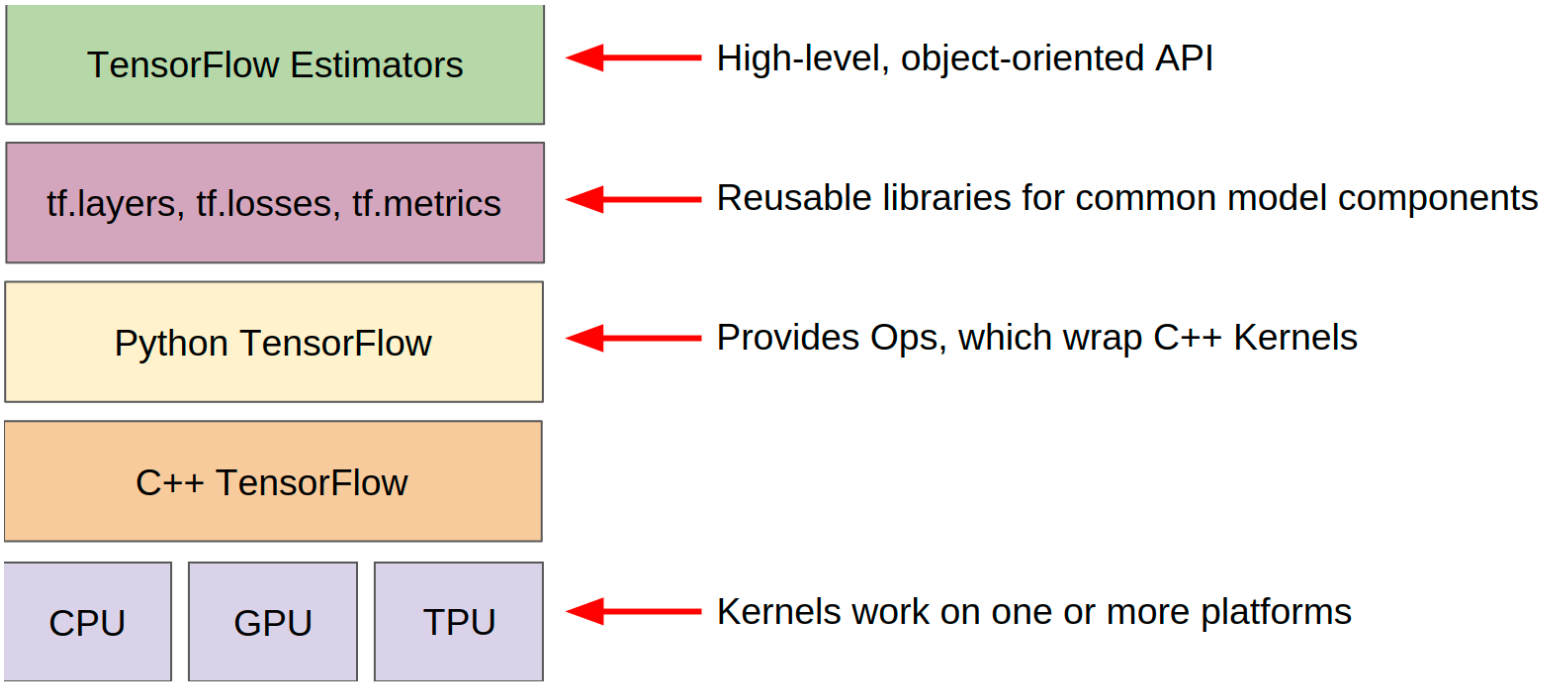


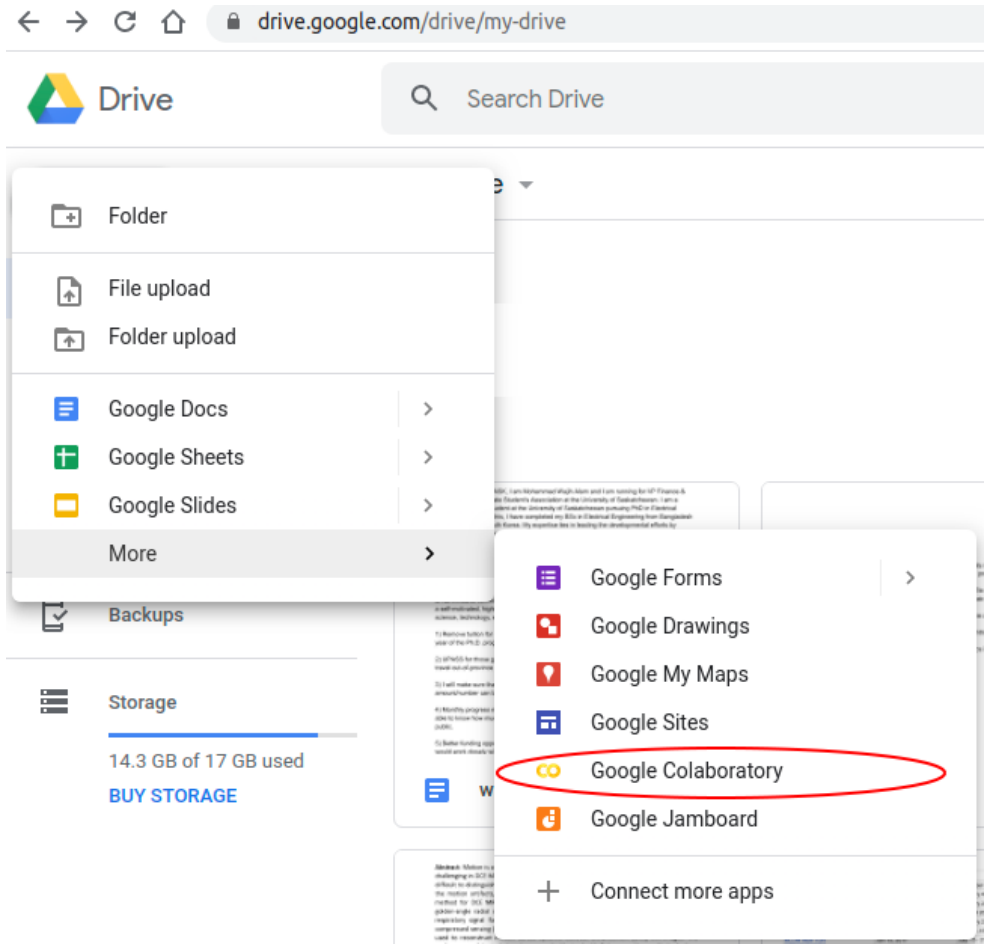
Image Source: developers.google.com

Environments

- CPU version of Tensorflow

```
pip install tensorflow==1.15.0
```

- GPU version requires CUDA Toolkit, docs at tensorflow.org/install
- Google Colab: colab.research.google.com



TensorFlow v1.x Demos

TensorFlow (v2.0)

- Eager execution:
  - TF v1.x: Graph creation, graph execution
  - TF v2.0: Identical behavior to normal python code
    - ⋆ Dynamic graphs
    - ⋆ In-order execution
- No more globals:
  - TF v1.x: a variable remain in memory even if you lost track of the Python variable pointing to it
  - TF v2.0: Keep track of your variables! If you lose track of a tf.Variable, it gets garbage collected.
- Functions, not sessions
  - TF v1.x: session.run()
  - TF v2.0: Decorate a Python function using tf.function() to mark it for JIT compilation
- Inter-mix core Python and TF
  - Use python along with TF v2.0 code
  - TF code executes in contexts without a python interpreter (Mobile, C++, JS)

Digression: Python Decorators

```
def my_decorator(func):
    def wrapper():
        print("Something before the function is called.")
        func()
        print("Something after the function is called.")
        return wrapper

def say_whee():
    print("Whee!")

say_whee = my_decorator(say_whee)
say_whee()

@my_decorator
def say_whee():
    print("Whee!")
say_whee()
```

source: https://realpython.com/primer-on-python-decorators/

TensorFlow 2.0 Demos

References

Abadi, M., Agarwal, A., Barham, P., Brevdo, E., Chen, Z., Citro, C., Corrado, G. S., Davis, A., Dean, J., Devin, M., et al. (2015). Tensorflow: Large-scale machine learning on heterogeneous systems, 2015. *Software available from tensorflow. org*, 1.