Tensorflow: Basic introduction

Dripta Mj
Department of Mathematics
Ramakrishna Mission Vivekananda Educational and Research Institute
Belur Math, India

Tensorflow

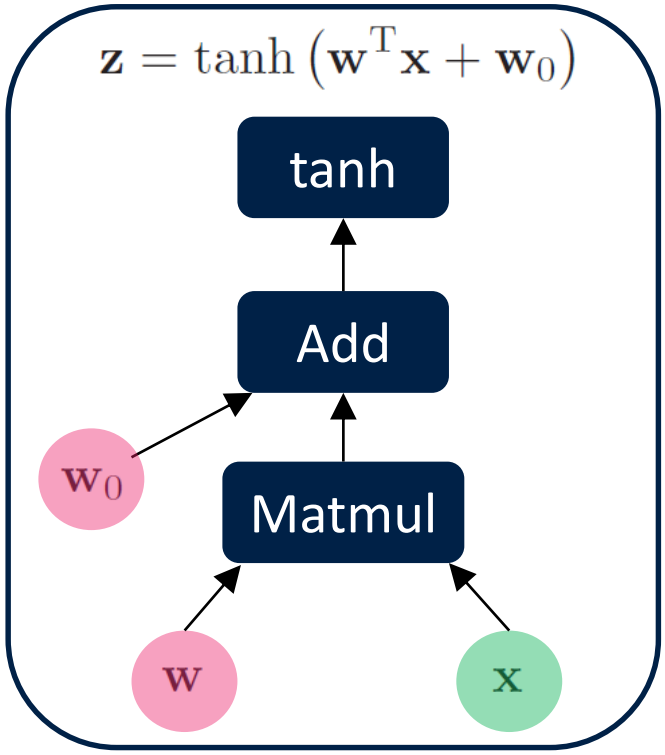
- Originally developed by the Google Brain team.
- Tensorflow represents all data by using a data structure called tensor.
- Tensorflow builds a computational graph to represent the data flow of the computations.
- Two key components of Tensorflow codes:
  - Create a computational graph
  - Run a session to execute the operations in the graph

Pic source : https://github.com/tensorflow/docs

Variables

```
import tensorflow as tf

w0 = tf.Variable(tf.zeros((10,)))
w = tf.Variable(tf.random_uniform((4,10),-1,1))
```



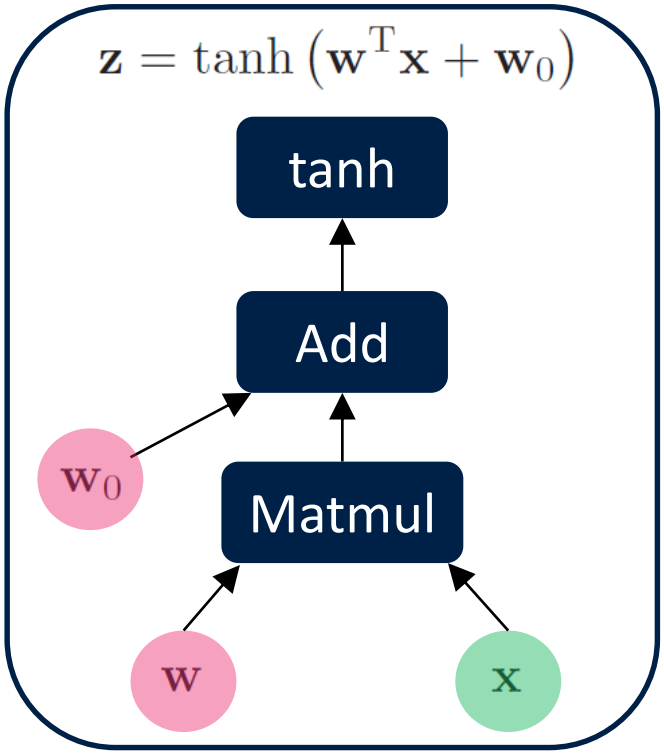
- Variables: represent states that retain can retain their current value over multiple executions.
  - The variable constructor requires an initial value, which can be a tensor of any type and shape.
  - Gradient update (default) will apply to all variables in the graph.

Placeholders

```
import tensorflow as tf

w0 = tf.Variable(tf.zeros((10,)))
w = tf.Variable(tf.random_uniform((4,10),-1,1))

x = tf.placeholder(tf.float32, (150,4))
```



- Placeholders: values are fed in at execution time.
  - Enables the graph to accept external inputs

Flow graph

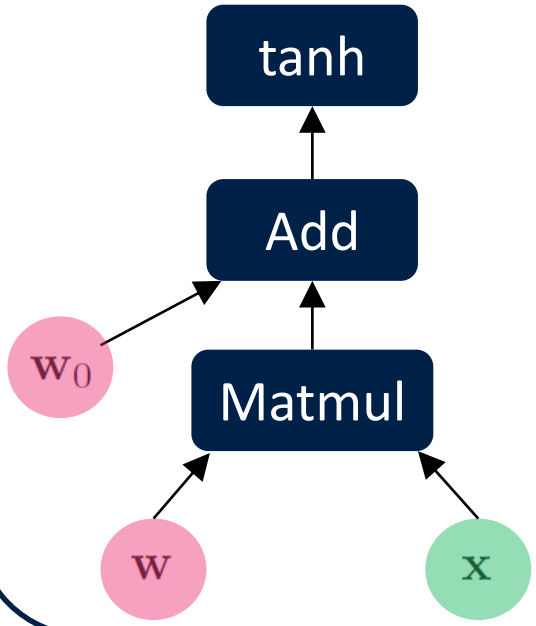
```
import tensorflow as tf

w0 = tf.Variable(tf.zeros((10,)))
w = tf.Variable(tf.random_uniform((4,10),-1,1))

x = tf.placeholder(tf.float32, (150,4))

z = tf.nn.tanh(tf.matmul(x, W) + w0)
```

$$\mathbf{z} = \tanh\left(\mathbf{w}^{\mathrm{T}}\mathbf{x} + \mathbf{w}_0\right)$$



Session

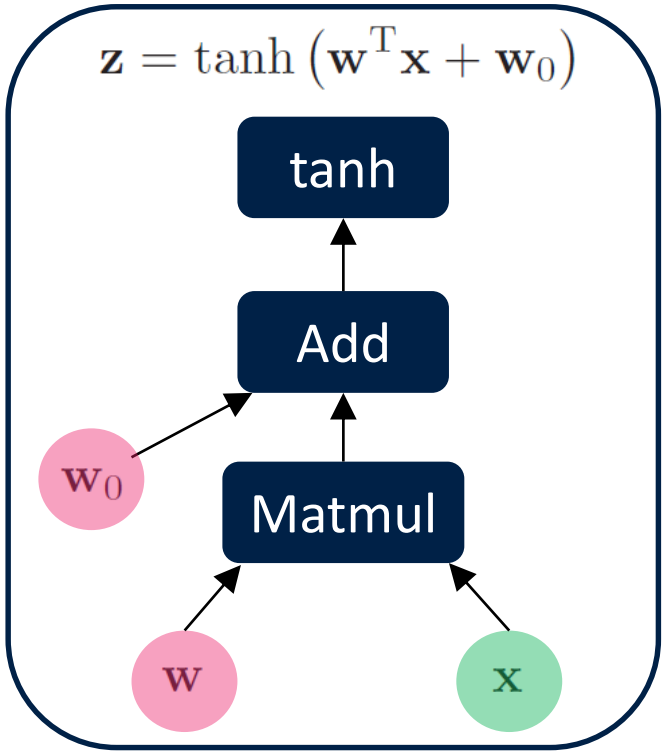
```
import tensorflow as tf

w0 = tf.Variable(tf.zeros((10,)))
w = tf.Variable(tf.random_uniform((4,10),-1,1))

x = tf.placeholder(tf.float32, (150,4))

z = tf.nn.tanh(tf.matmul(x, W) + w0)


sess = tf.Session()
init = tf.initialize_all_variables()
sess.run(init)
```



- Creating the session runs the graph that contains the tensors and operations.
  - Graph provides the schema while a session processes a graph.

Gradient computation

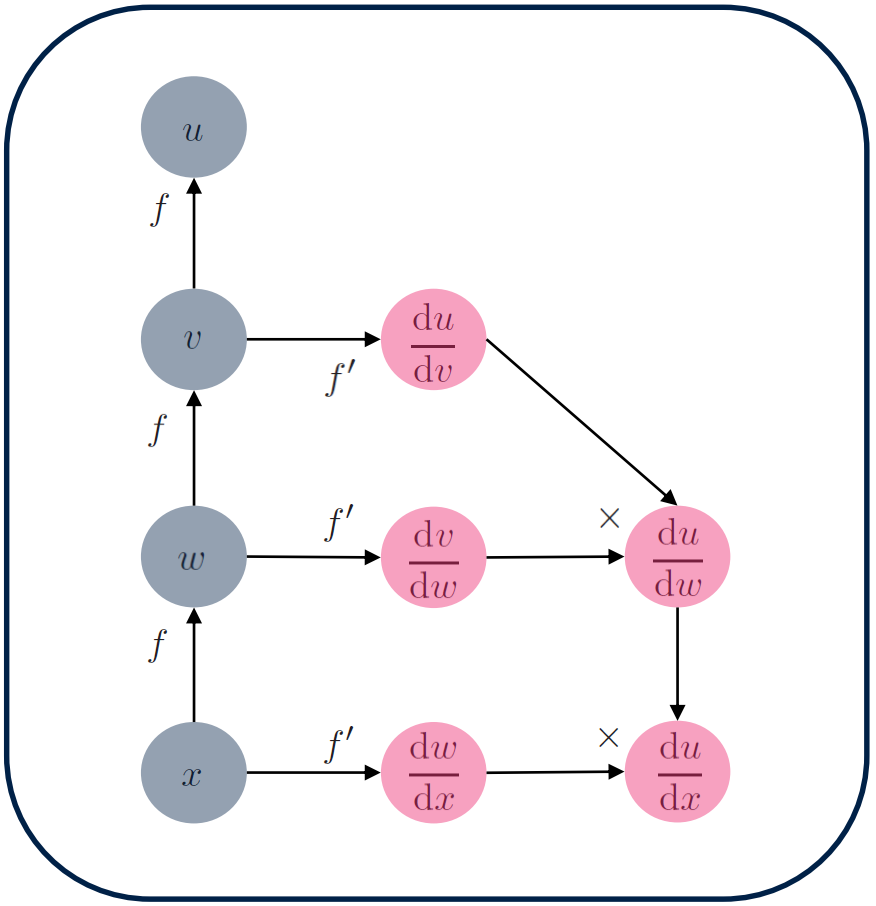
$$w = f(x)$$

$$v = f(w)$$

$$u = f(v)$$

$$u = f(f(f(x)))$$

$$\frac{\mathrm{d}u}{\mathrm{d}x}?$$



- Derivatives are another computational graph.

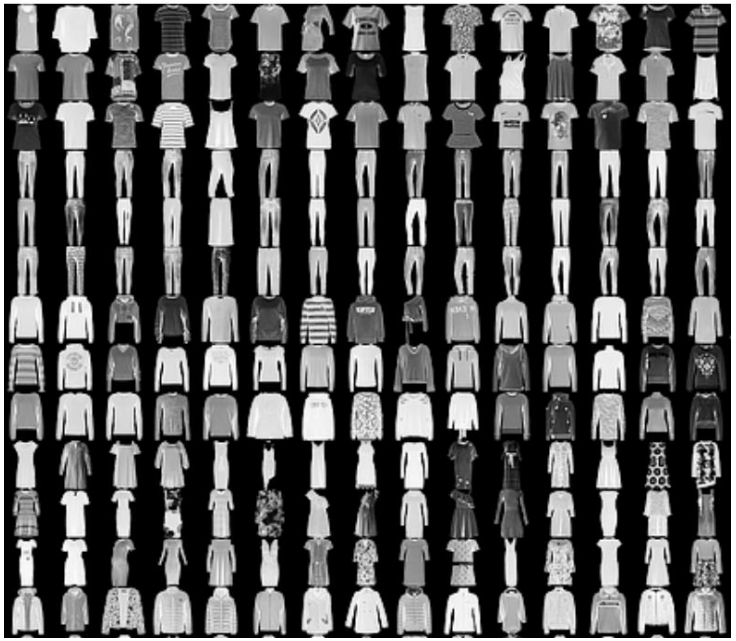
Based on an example in Deep Learning, MIT Press

Keras

- Keras is a high-level neural network API, written in Python.
- Capable of running on top of TensorFlow and some other libraries.
- Enables fast experimentation with deep neural networks

Pic source: https://keras.io/

Fashion-MNIST



Label	Description
0	T-shirt/top
1	Trouser
2	Pullover
3	Dress
4	Coat
5	Sandal
6	Shirt
7	Sneaker
8	Bag
9	Ankle boot

- Dataset comprises article images – 60,000 training examples and 10,000 test examples
- Each example is a 28 × 28 grayscale image, associated with a label from 10 classes
  - A total of 784 pixels in each image.
  - Each pixel-value indicates the darkness/lightness of that pixel, with higher numbers meaning darker.
  - Pixel-value is an integer between 0 and 255.

Content source: https://github.com/zalandoresearch/fashion-mnist