



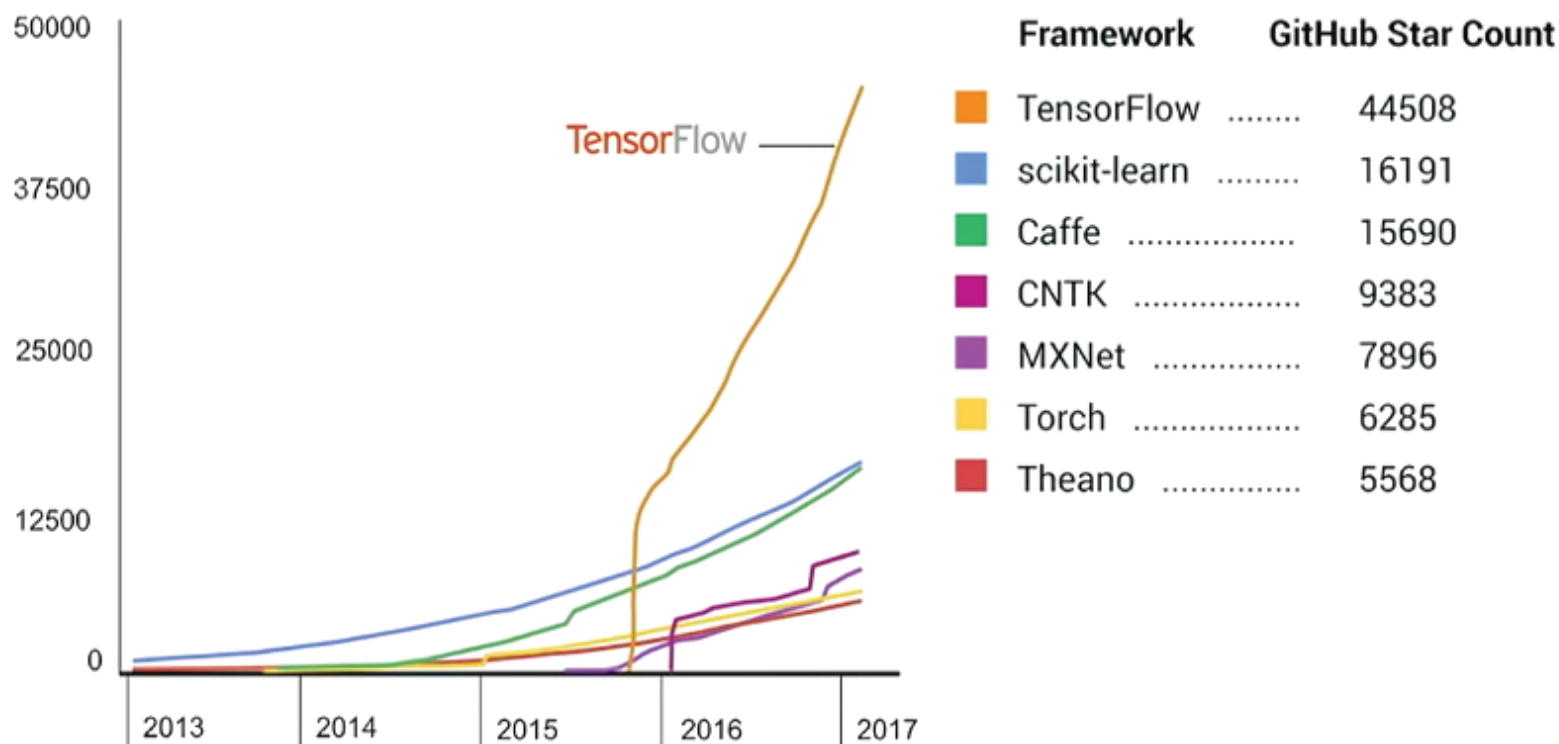
# Introduction to TensorFlow

[https://www.tensorflow.org/get\\_started/get\\_started](https://www.tensorflow.org/get_started/get_started)  
<https://www.tensorflow.org/tutorials/>



# Why TensorFlow?

- Has the largest user community
- Well documented
- Most popular Deep Learning framework





# What is TensorFlow?

- A Deep Learning library open-sourced by Google Brain
- Provides primitives for defining functions on **tensors** and automatically computing forward outcomes and backward derivatives
- Designed for neural computation using data **flow** graphs



# What is a Tensor?

Tensor =  $n$ -dimensional matrix

A tensor can be:

a scalar

a vector

a matrix

$$T = \begin{array}{|c|} \hline \begin{array}{cccc} X_{111} & X_{112} & X_{113} & \dots & X_{11N} \\ X_{121} & X_{122} & X_{123} & \dots & X_{12N} \\ X_{131} & X_{132} & X_{133} & \dots & X_{13N} \\ \vdots & \vdots & \vdots & \ddots & \vdots \\ X_{N11} & X_{N12} & X_{N13} & \dots & X_{N1N} \end{array} \\ \hline \end{array}$$



# What is a Data Flow Graph?

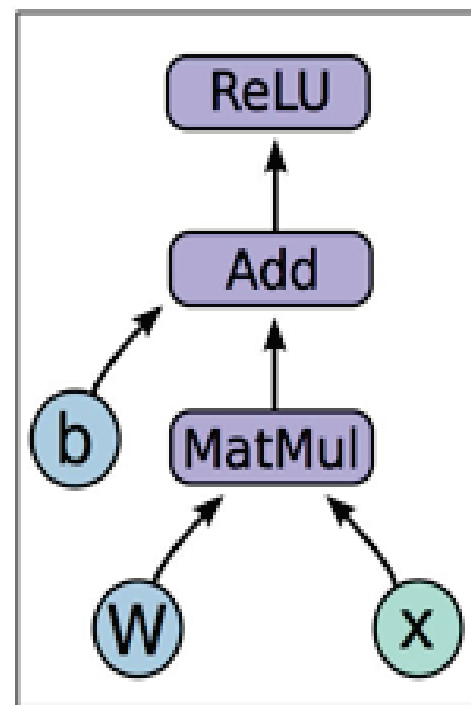
- Computations are represented as **graphs**:

- Nodes are the operations (ops)
- Edges are the Tensors

$$h = \text{ReLU}(Wx + b)$$

- Typical program consists of 2 phases:

- **Construction** phase:  
Assembling a graph (a model)
- **Execution** phase:  
Pushing data through the graph

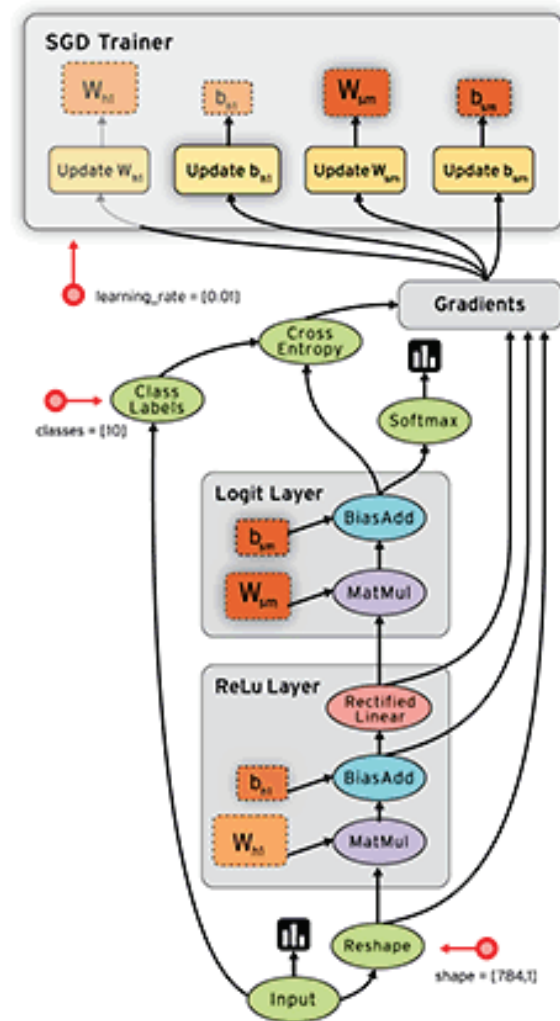




# An Example of Data Flow Graph

## A two layers Neural Network

- Input:  $X$
- First layer:
$$H = \text{ReLU}(W1 * X + b1)$$
- Second layer:
$$O = \text{Softmax}(W2 * H + b2)$$

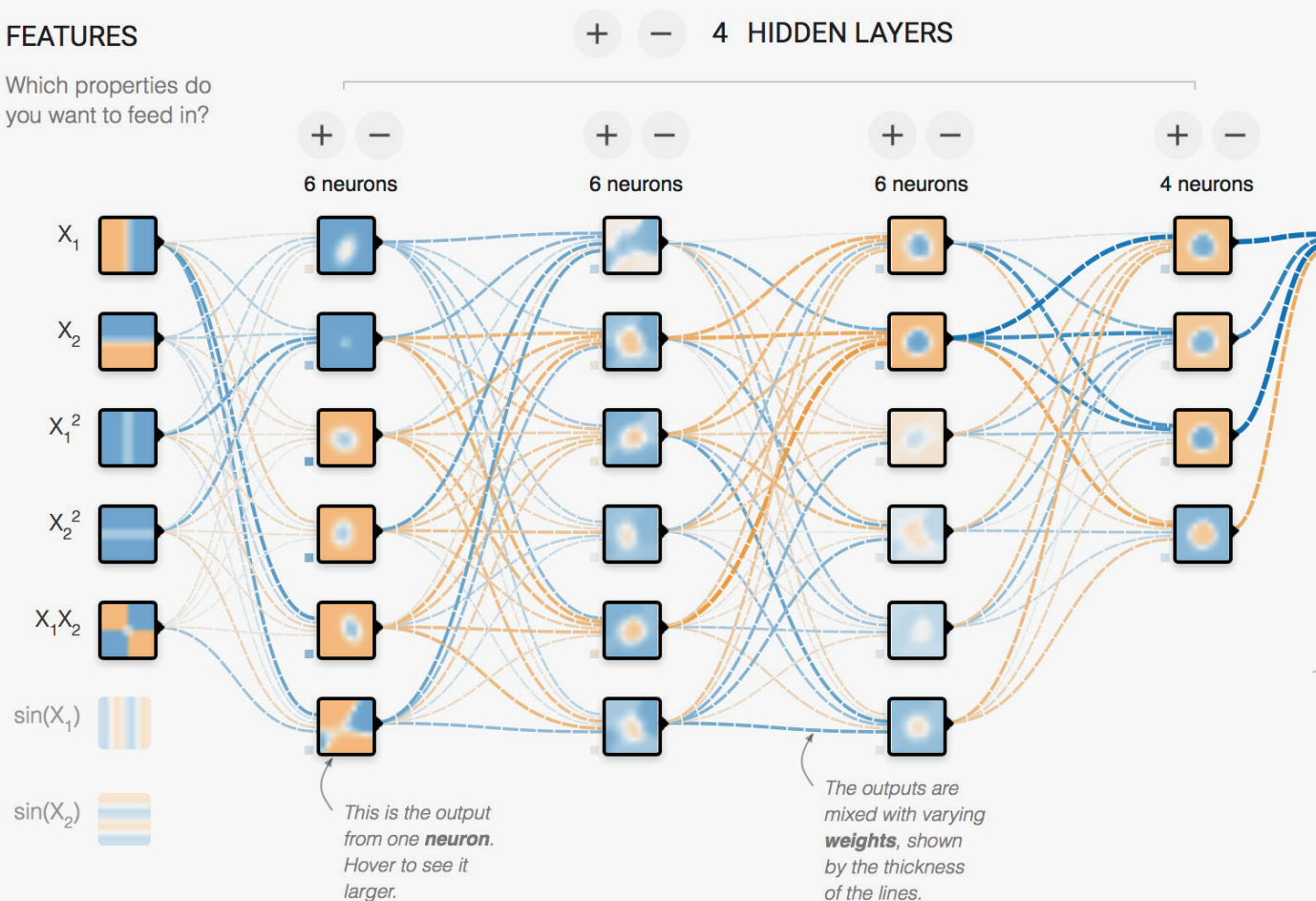




# An Example of Data Flow Graph

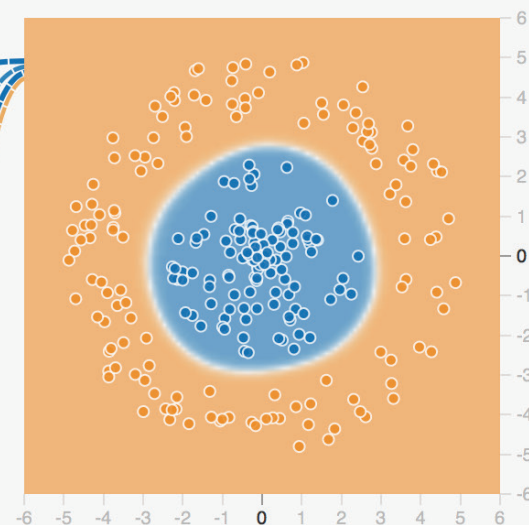
## FEATURES

Which properties do you want to feed in?

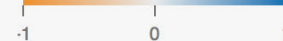


## OUTPUT

Test loss 0.000  
Training loss 0.000



Colors shows data, neuron and weight values.



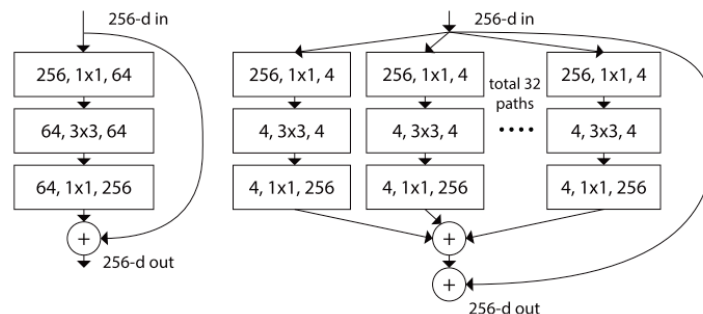
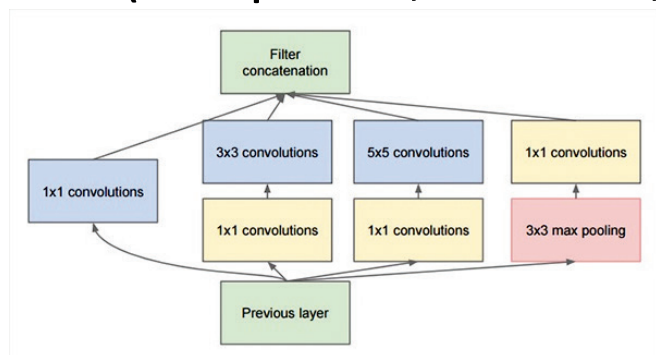
☐ Show test data   ☐ Discretize output

Tensorflow playground: <http://playground.tensorflow.org/>

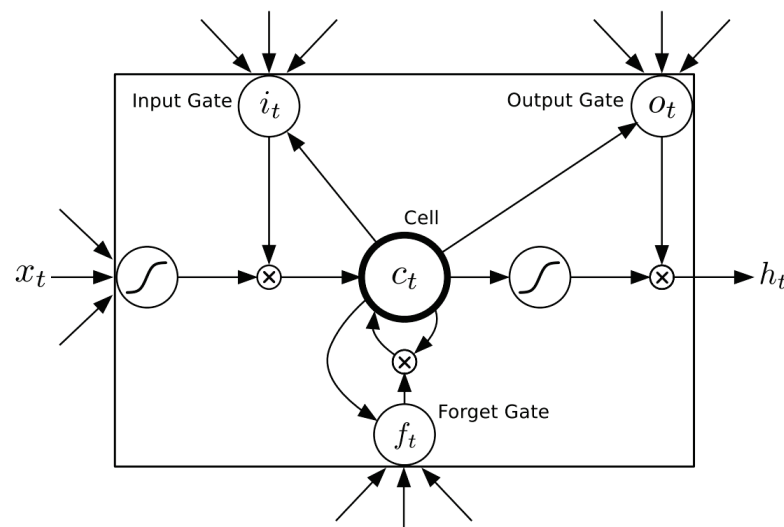
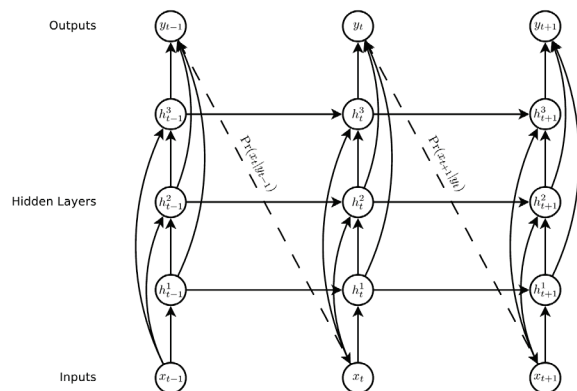


# Why use TensorFlow?

- Flexibility of designing & testing complex network structures:
  - CNNs (Inceptions, ResNets, ....)



- RNNs (LSTMs, GRU, .....)

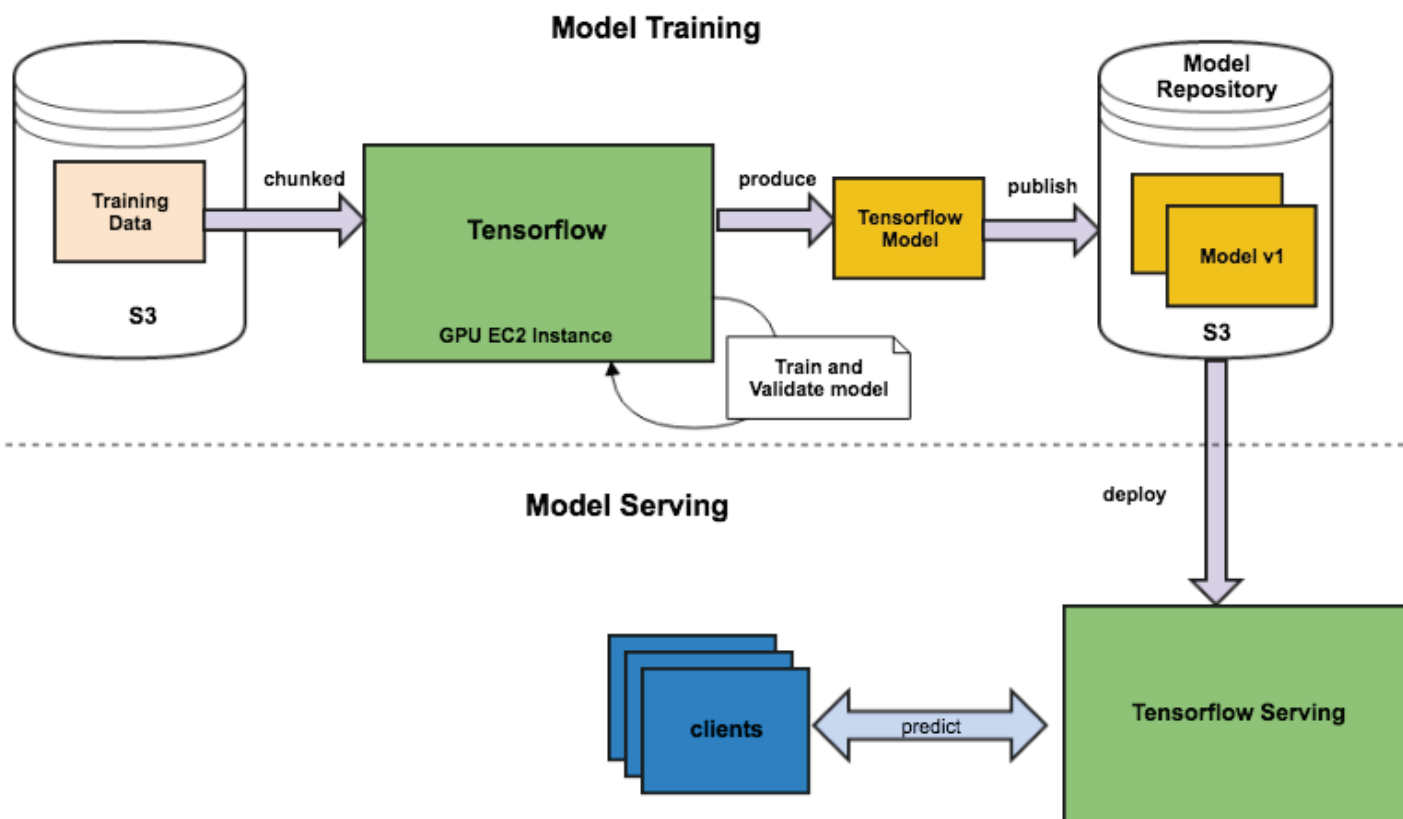






# Why use TensorFlow?

- Seamless transition from model training to deployment:





# Why use TensorFlow?

- Other benefits:
  - ✓ More stable API,
  - ✓ Better documentation and more advanced tools,
  - ✓ Runs on clouds, mobiles, desktops, ...