```
from tensorflow
import learn
```

github.com/nithishdivakar

Nithish Divakar

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github.com/nithishdivakar

“ Talk is cheap. Show me the code ” –Linus Torvalds

```
|--github.com
   |--nithishdivakar
      |--Talks-and-Tutorials
         |--tfTalk-03June2017
            |-- README.md
```

link

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“Practice makes permanent ” –Bobby Robson

What can something not do?

What can something do?

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What can TensorFlow do?

TensorFlow^{TM} is an open source software library for numerical computation using data flow graphs. Nodes in the graph represent mathematical operations, while the graph edges represent the multidimensional data arrays (tensors) communicated between them.

–tensorflow.org

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$$\min_{x}(x-a)^2$$

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analytical solution

$$\min_x (x-a)^2$$

$$\frac{df}{dx} = 2x - 2a$$

$$\frac{df}{dx} = 0 \implies \mathbf{x = a}$$

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numerical solution

$$\min_x (x - a)^2$$

$$x^{new} = x^{old} - \alpha \frac{df}{dx}$$

gradient descent

Doesn't care what f is as long as df/dx is available

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Demo: `01aWhatCanBeDone.ipynb`

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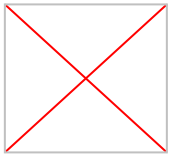
$$\min_{x} \quad (x-a)^2$$

$$\text{s.t} \quad x = b$$



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$$\min_{x} \quad (x-a)^2 \quad \text{s. t} \quad x = b$$

$$\equiv$$

$$\min_{x} \quad (x-a)^2 + C(x-b)$$

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Demo: `01bWhatCanBeDone.ipynb`

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TensorFlow™ is an open source software library for numerical computation using data flow graphs. Nodes in the graph represent mathematical operations, while the graph edges represent the multidimensional data arrays (tensors) communicated between them.

–tensorflow.org

How represent computation?

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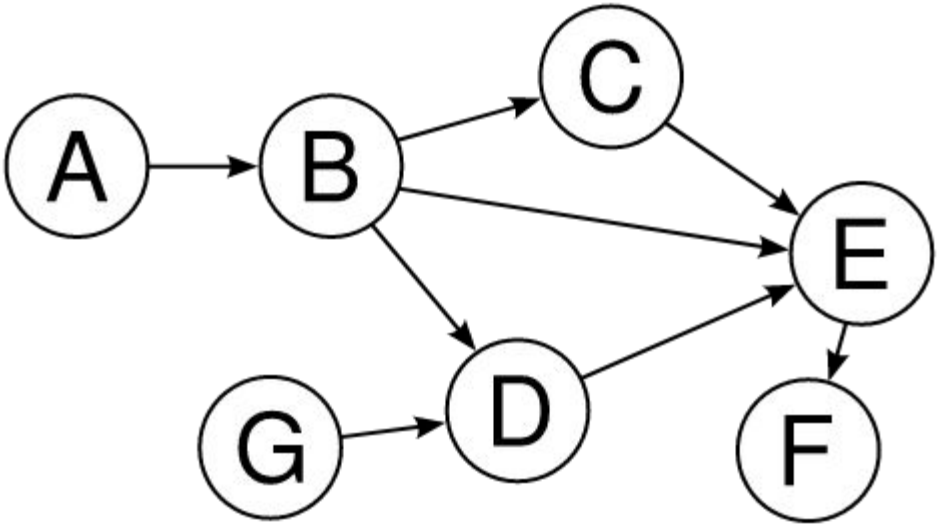
Graphical Models



$$P[X_1, X_2, \ldots X_n] = \prod_i P[X_i | parents_i]$$

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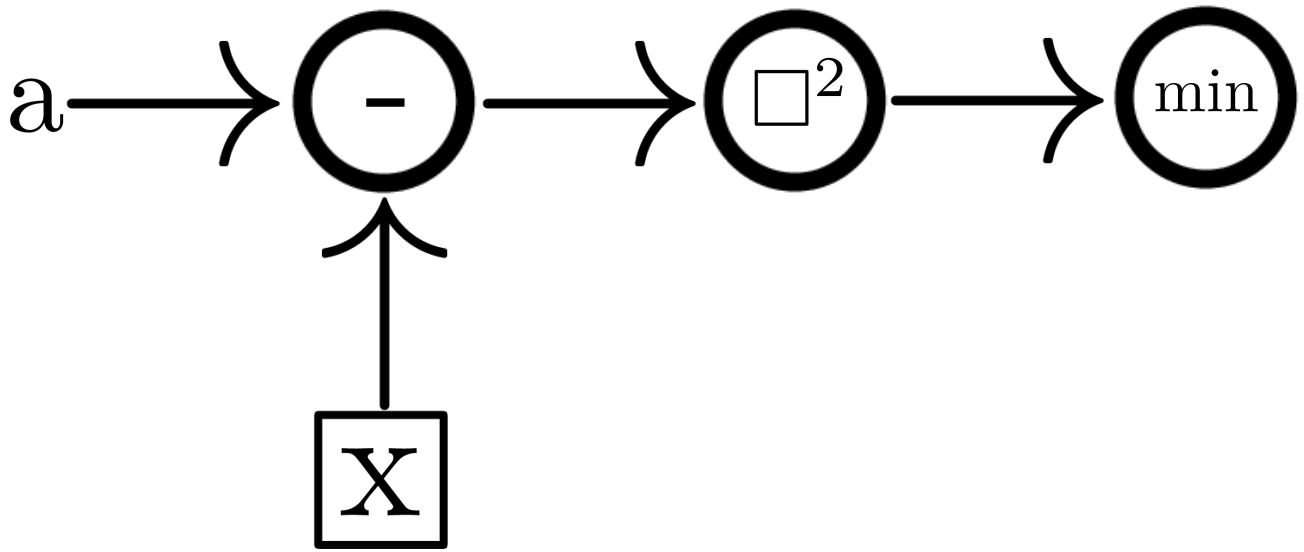
Computational Graph



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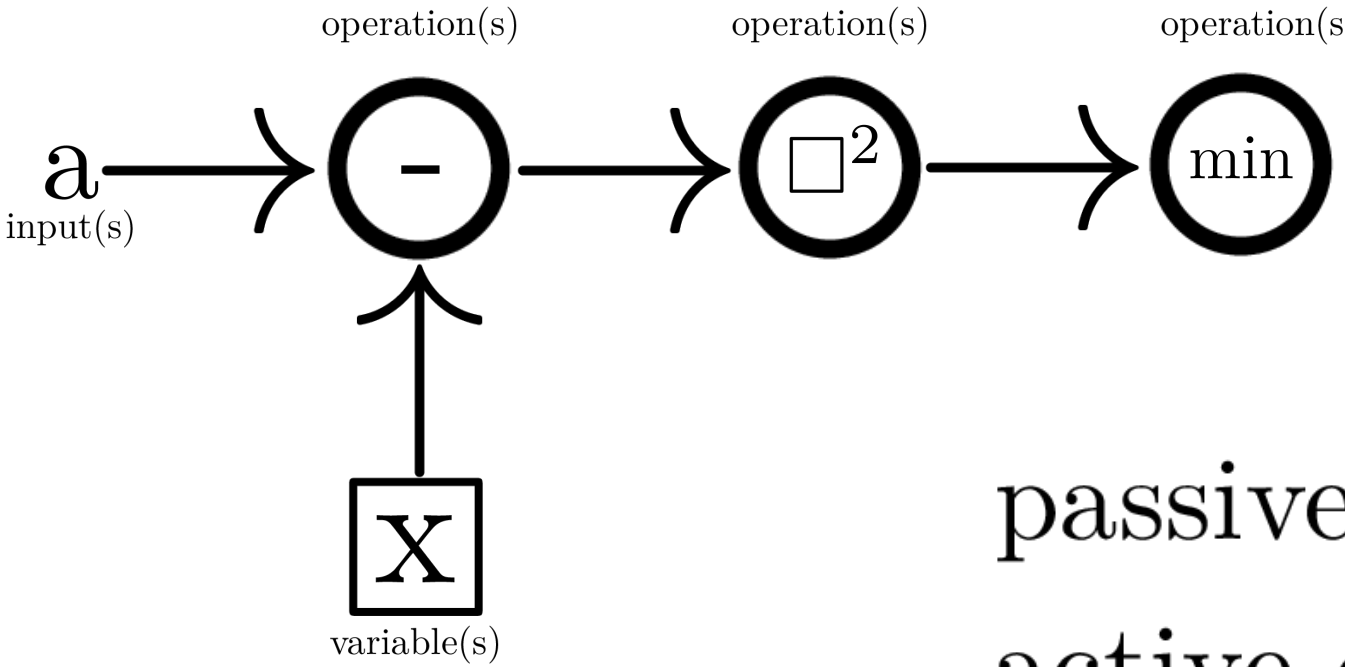
Computational Graph



passive ops ?

active ops ?

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Linear Regression

$$L(y, \hat{y}) = \|y - \hat{y}\|^2$$

$$\hat{y} = Wx + b$$

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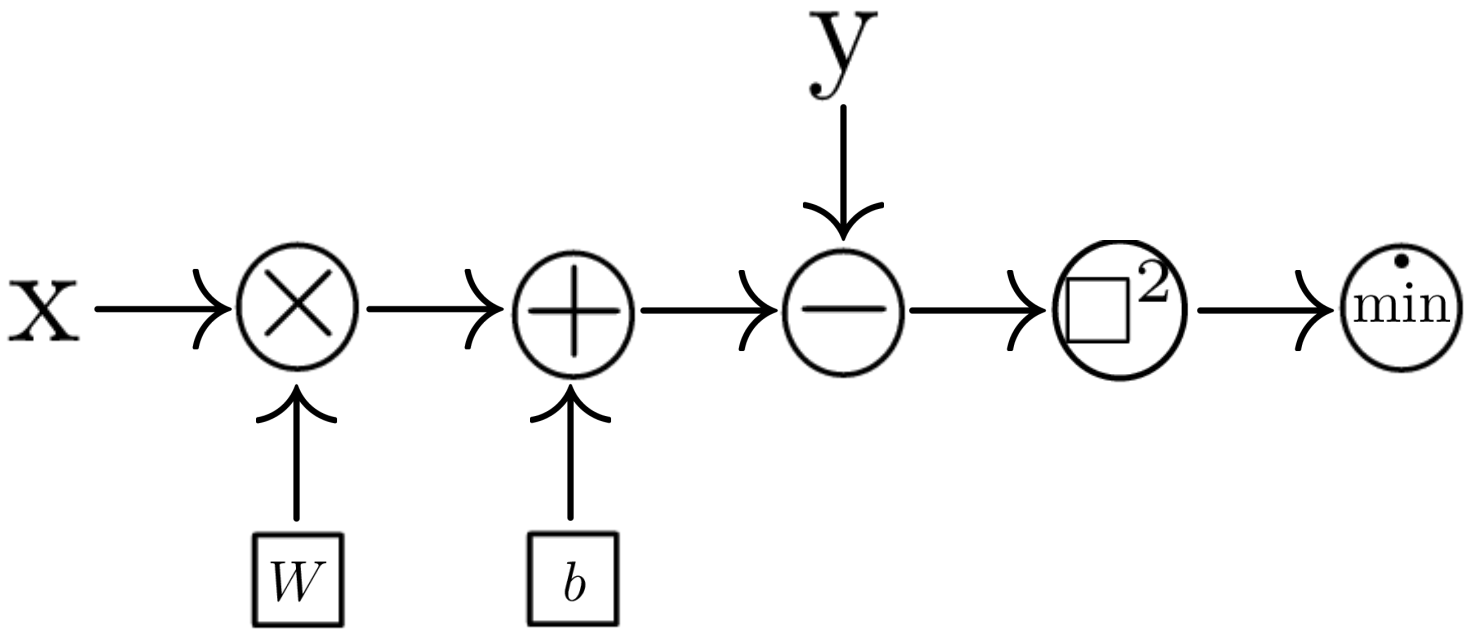

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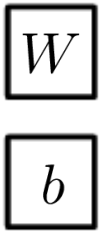
`tf.placeholder()`



`tf.Variable()`

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Demo: `02LinearRegression.ipynb`

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Logistic Regression

$$P[y = 1|x] = \text{sigmoid}(Wx + b) = \hat{y}$$

$$L(y, \hat{y}) = y \log \hat{y} + (1 - y) \log(1 - \hat{y})$$

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Demo: `03LogisticRegression.ipynb`

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Multi Layer Perceptron

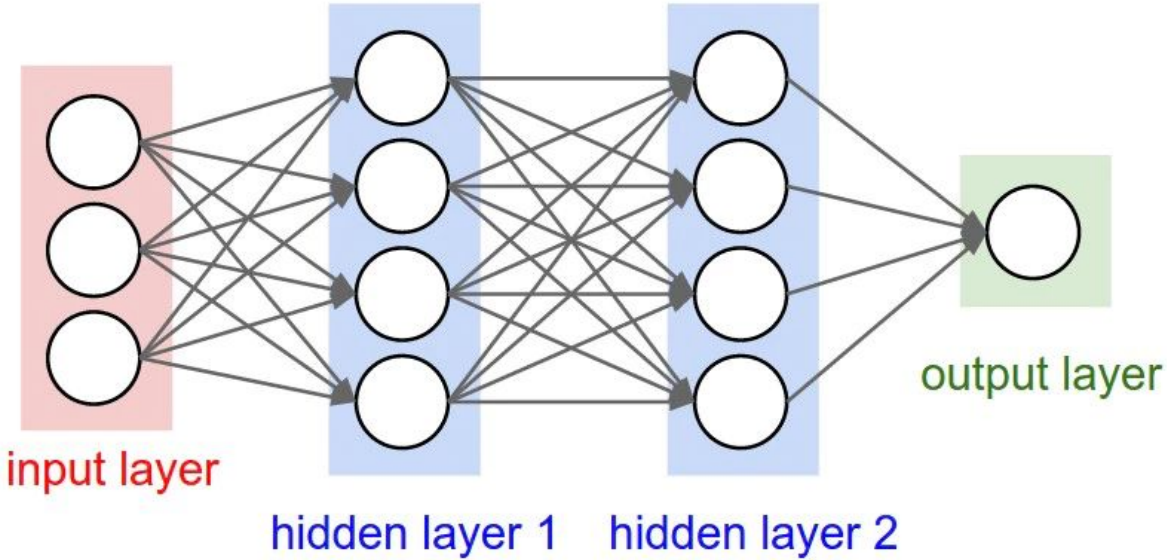

image credits: http://cs231n.github.io/neural-networks-1/

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lazy computational graph

$$
\begin{aligned}
x, y &= inputs \\
z_1 &= W_1 x + b_2 \\
a_1 &= relu(z_1) \\
z_2 &= W_2 a_1 + b_2 \\
\hat{y} &= sigmoid(z_2) \\
L(y, \hat{y}) &= crossentropy(y, \hat{y})
\end{aligned}
$$

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$$
\begin{aligned}
x, y &= inputs \\
z_1 &= W_1 x + b_2 \\
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\hat{y} &= sigmoid(z_2) \\
L(y, \hat{y}) &= crossentropy(y, \hat{y})
\end{aligned}
$$

$\{W_1, W_2, b_1, b_2\}$ `tf.Variable`

$\{x, y\}$ `tf.placeholder`

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Things are getting big

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Things are getting big

We are getting into deep learning..!!

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Organising your project

What are the parts of an ML experiment?

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Organising your project

What are the parts of an ML experiment?

Model - Train - Losses

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Demo: `04mlp`

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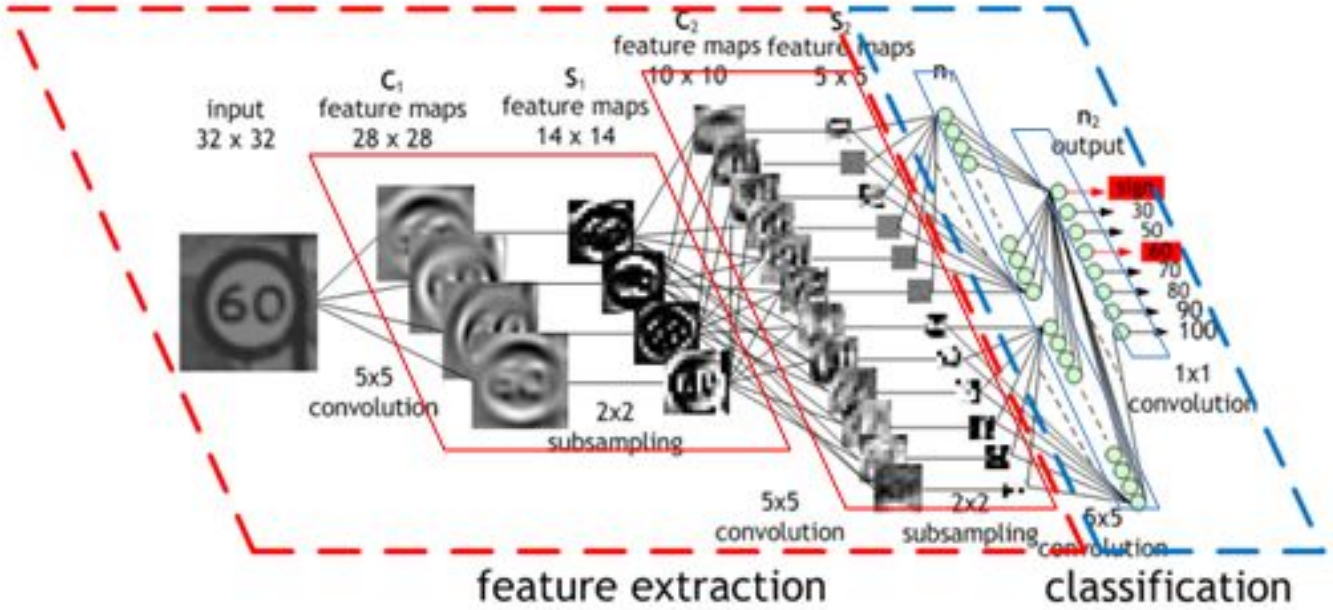
Convolutional Neural Networks



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What has changed?

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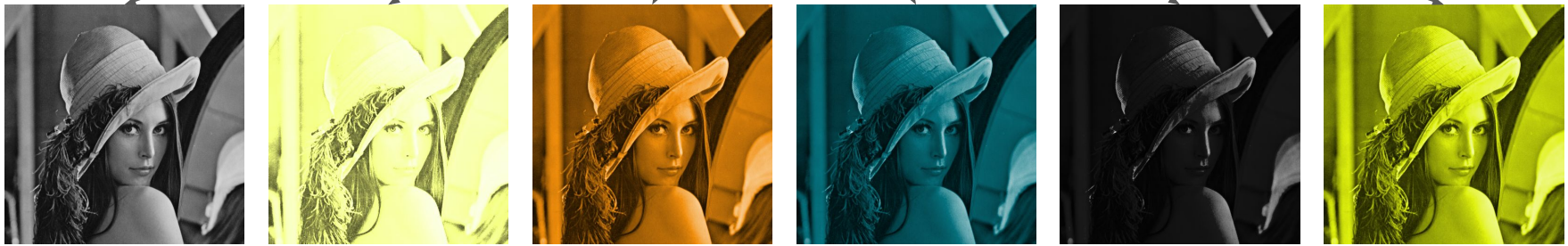

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Doing convolutions

```
tf.nn.conv2d(input, filter, strides, padding)
```

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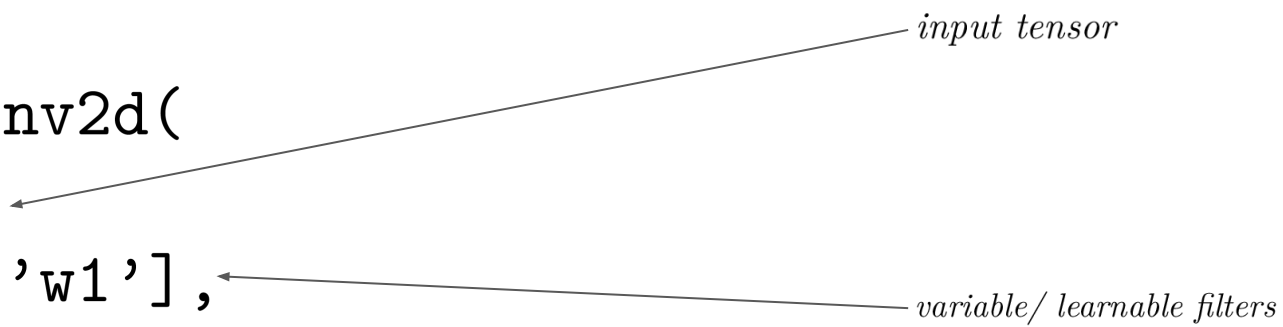
Doing convolutions

```
tf.nn.conv2d(input, filter, strides, padding)
```

```
tf.nn.conv2d(
  image,
  Theta['w1'],
  strides=[1, 2, 2, 1],
  padding='SAME'
)
```



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Demo: `05cnn`

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tensorboard

Demo: `06cnn`

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