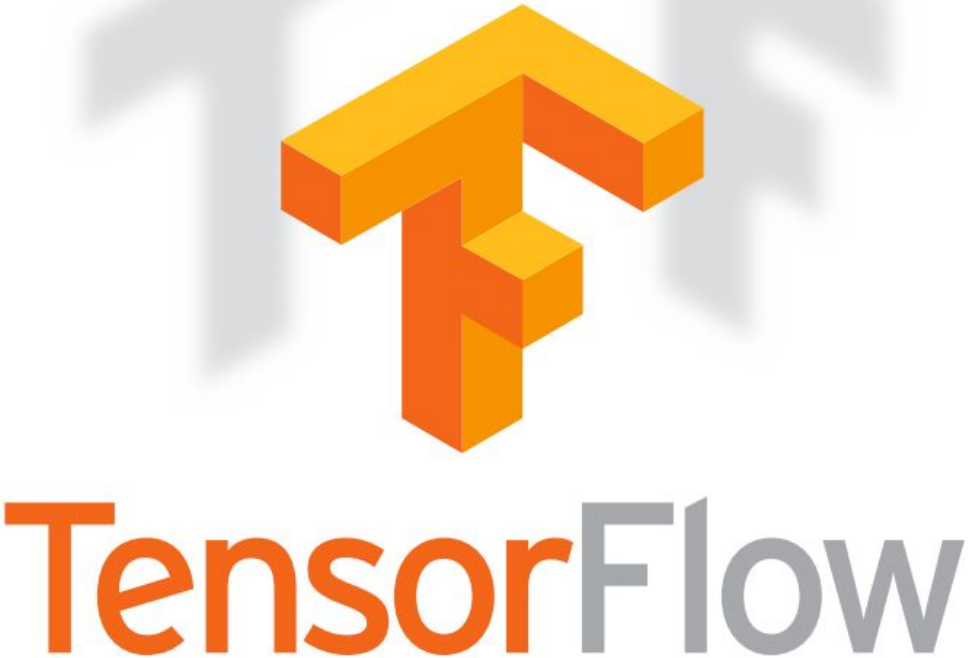
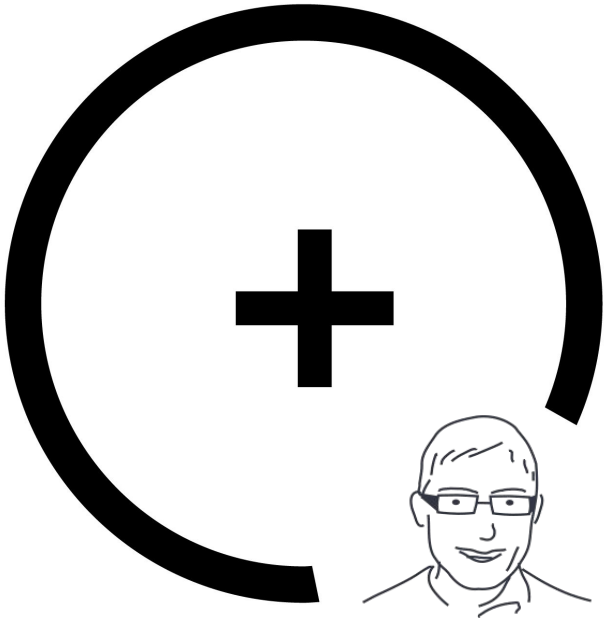


Introduction to TensorFlow

GDG Cloud Belgium
29/09/2016

Matthias Feys



About myself (Matthias Feys)

work at Datatonic:

- Big Data (Dataflow/Spark)
- Machine Learning (TensorFlow/sklearn)
- DataViz (Tableau/Spotfire)

Google Qualified Developer

Contact me:

- @FsMatt
- matthias@datatonic.com

Agenda

1. What is TensorFlow?

2. Why would you use it?

3. How does it work? + Demo

4. CloudML (alpha) discussion

TensorFlow

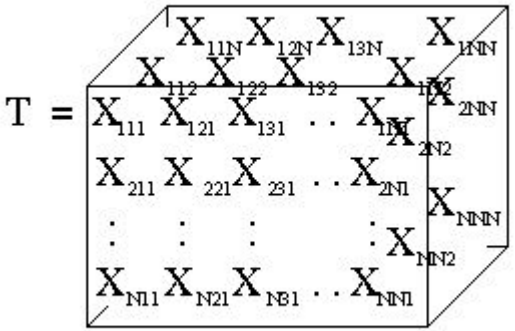
Google TensorFlow

- Originally developed by the **Google** Brain Team within Google's Machine Intelligence research organization
- TensorFlow provides primitives for defining functions on **tensor**s and automatically computing their derivatives.
- An open source software library for numerical computation using **data flow graphs**

Tensor?

Simply put: Tensors can be viewed as a **multidimensional array of numbers**.
This means that:

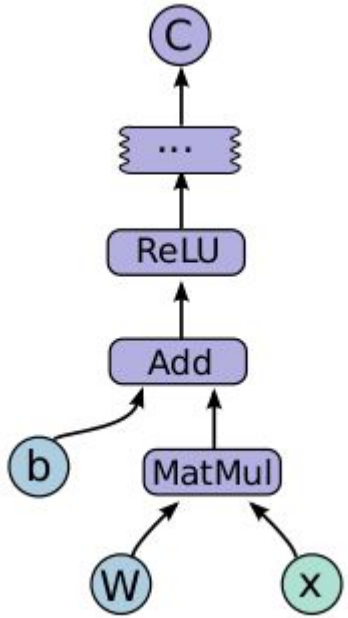
- A scalar is a tensor,
- A vector is a tensor,
- A matrix is a tensor
- ...



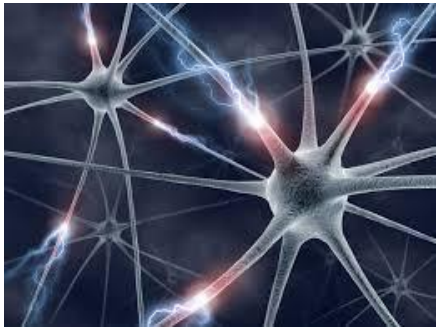
Data Flow Graph?

- Computations are represented as **graphs**:
  - Nodes are the operations (*ops)*
  - Edges are the *Tensors* (multidimensional arrays)

- Typical program consists of 2 phases:
  - **construction phase**: assembling a graph (model)
  - **execution phase**: pushing data through the graph

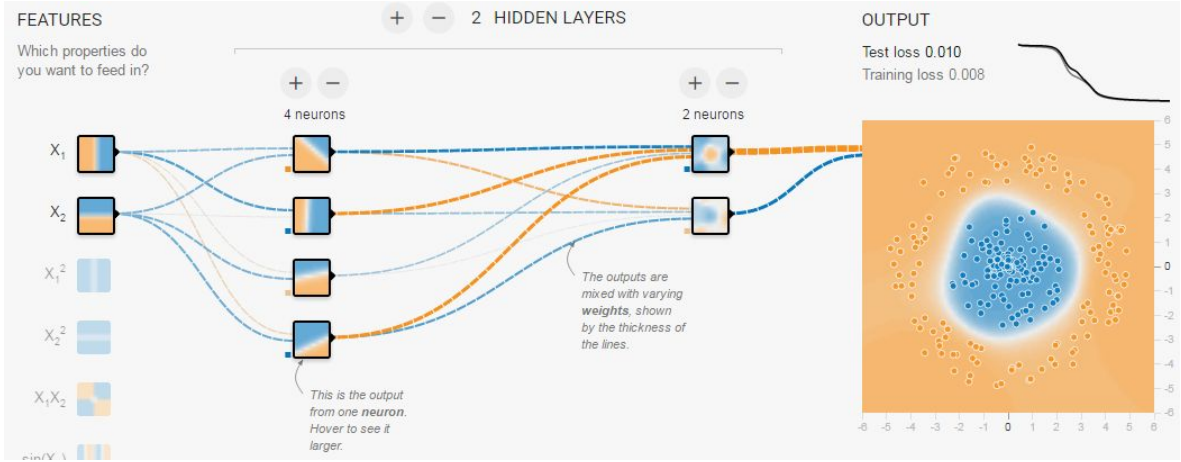


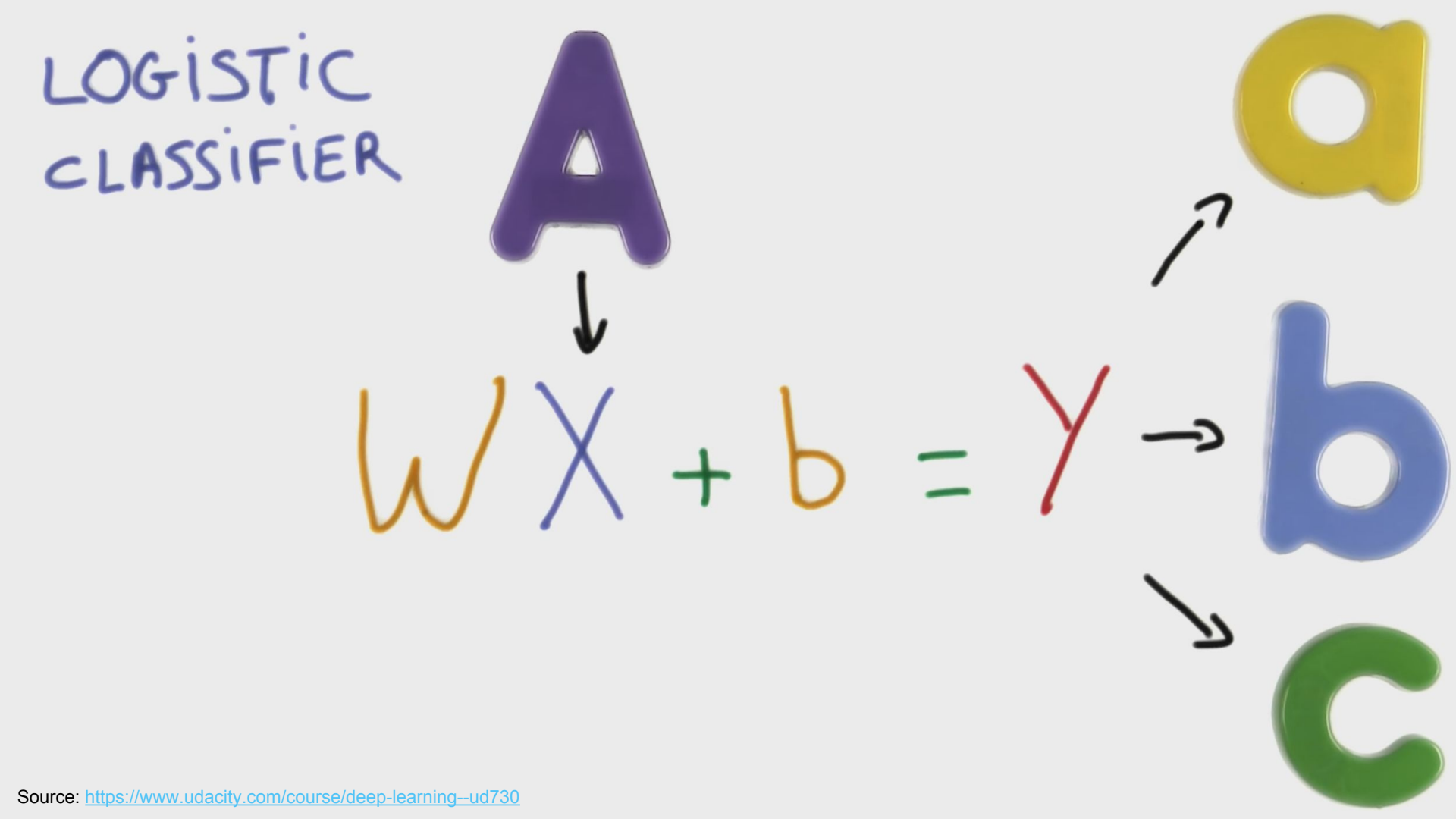
Neural Networks? Deep Learning?



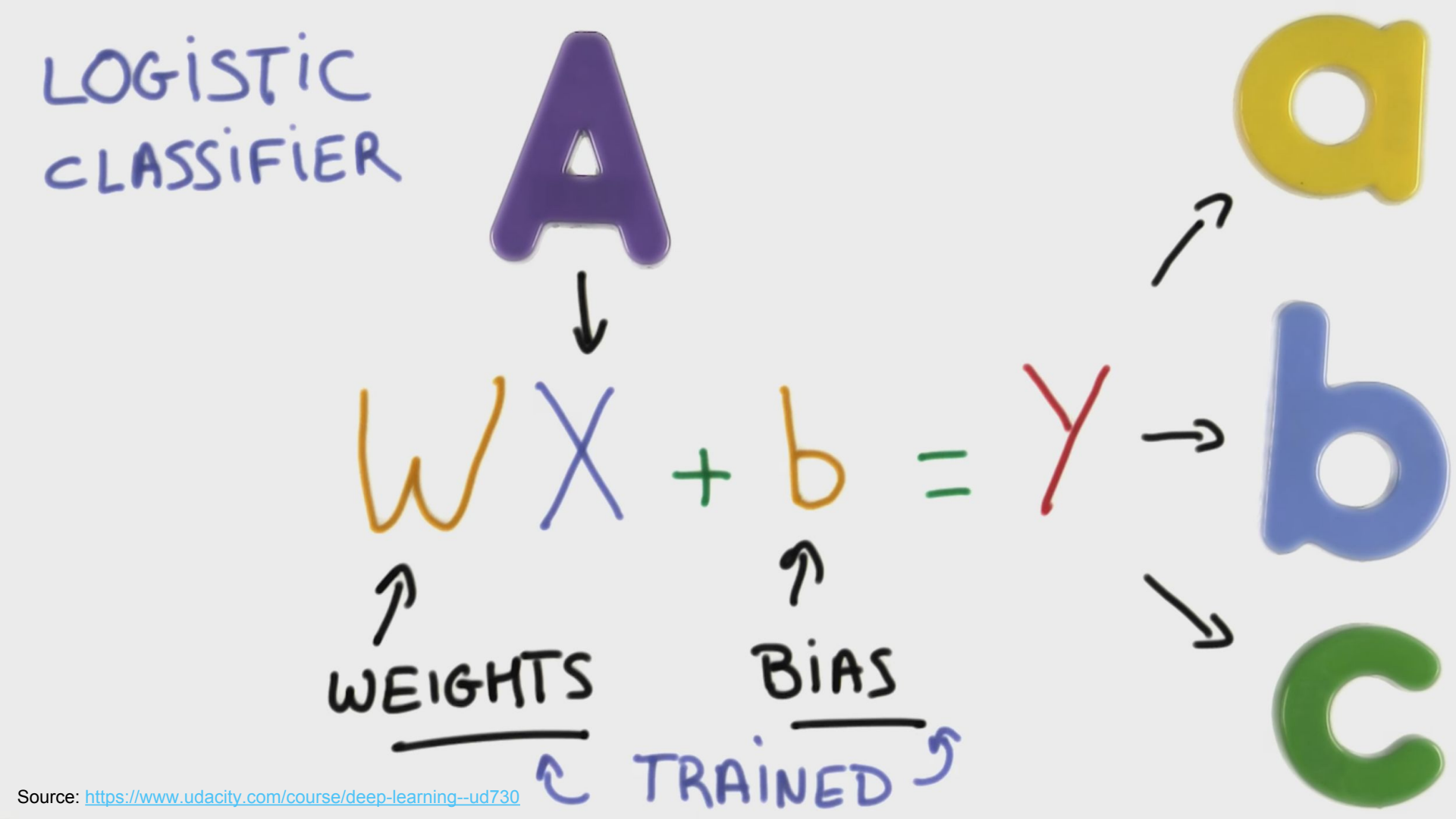
- Neural Networks are represented by the lower figure, not the top one....
- Link:

  [Tinker with a Neural Network in Your Browser]

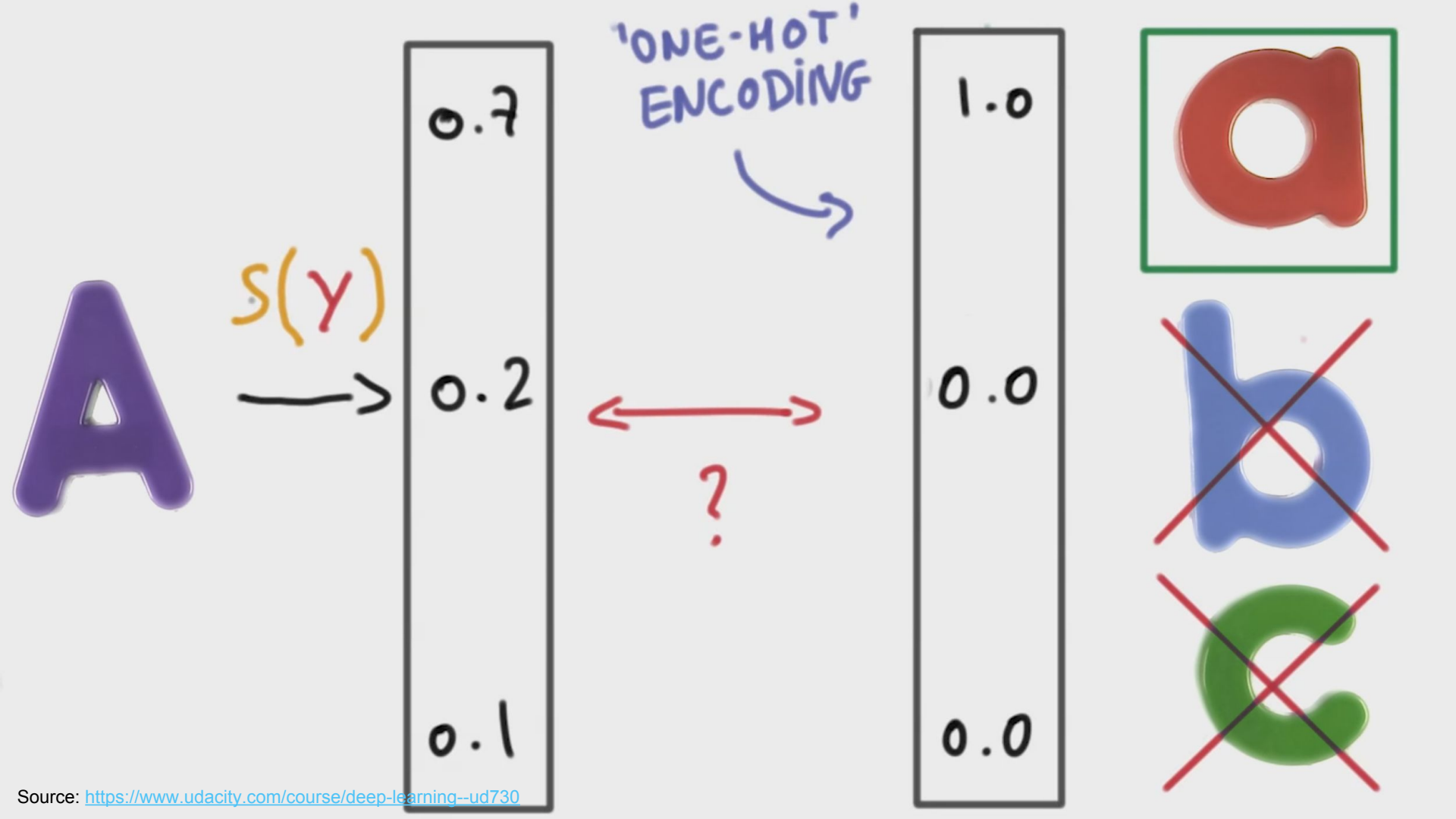




Source: https://www.udacity.com/course/deep-learning--ud730



Source: https://www.udacity.com/course/deep-learning--ud730



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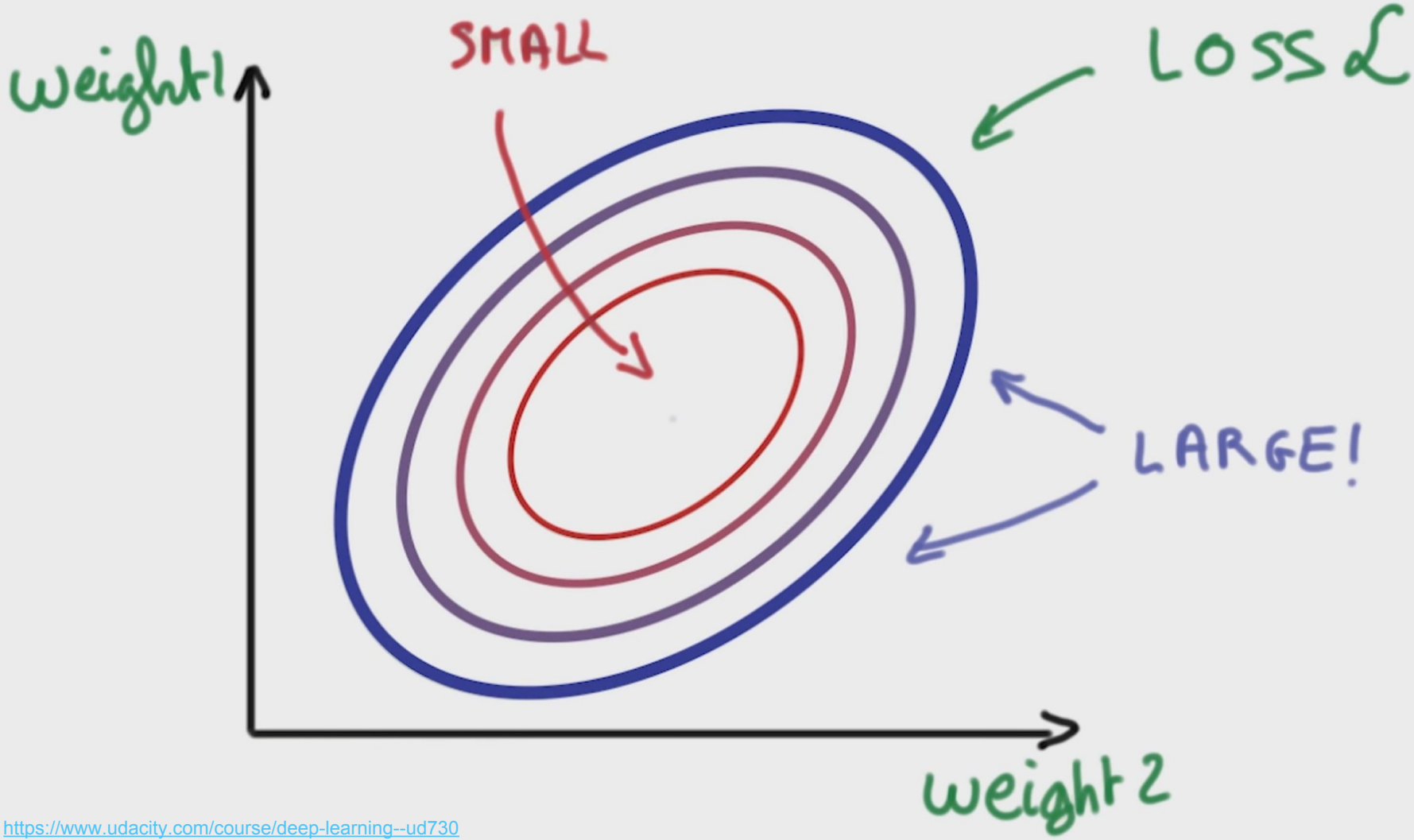

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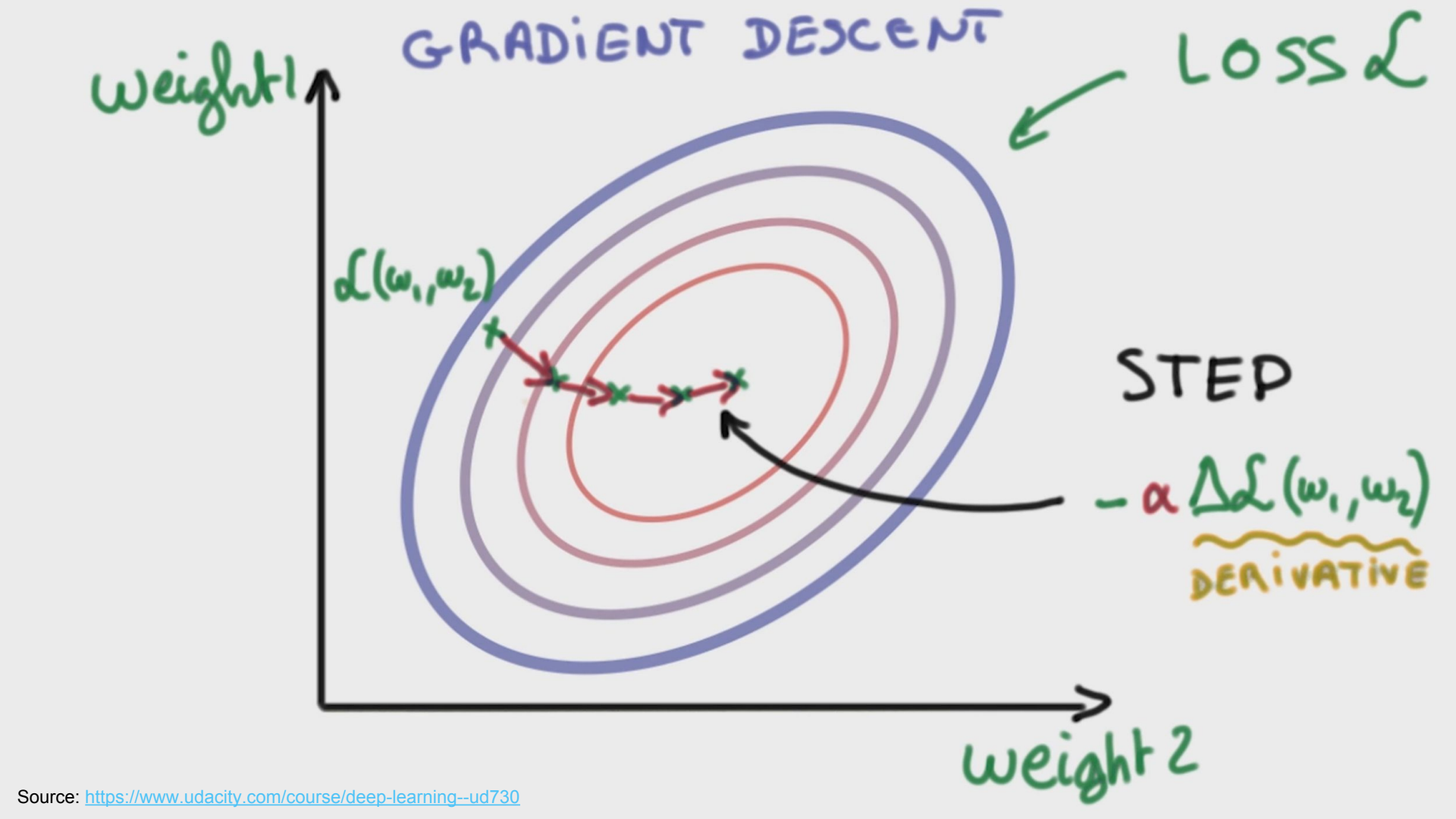


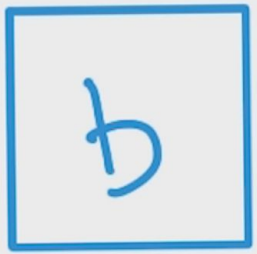
Source: https://www.udacity.com/course/deep-learning--ud730

LINEAR MODEL COMPLEXITY

X → × W → +b → Y → S(Y) → [0 1 0 0 0] ← 'B'

28

28

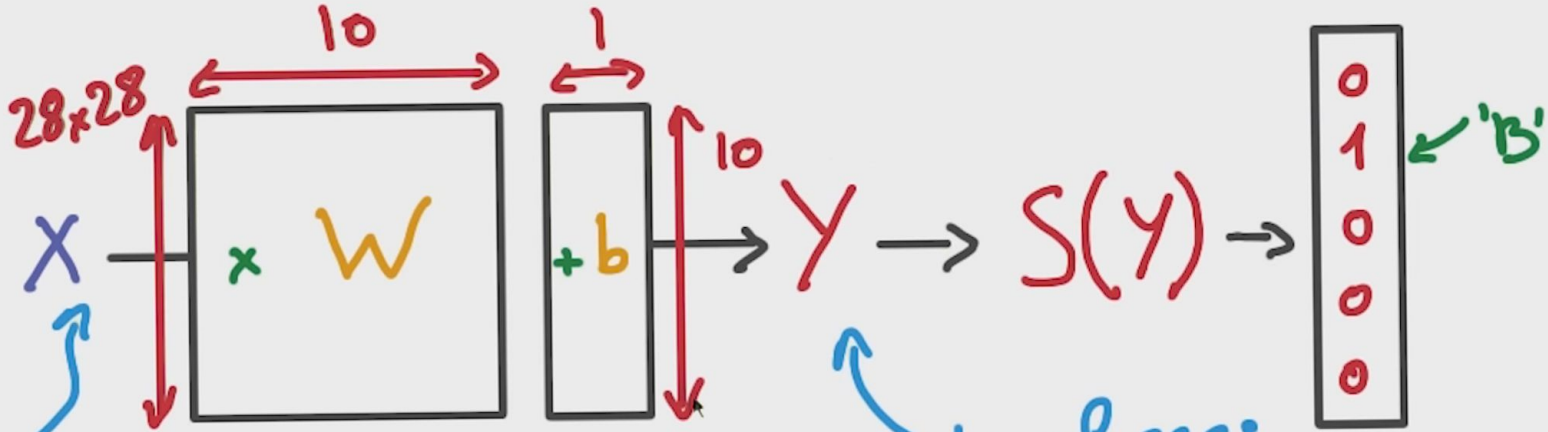


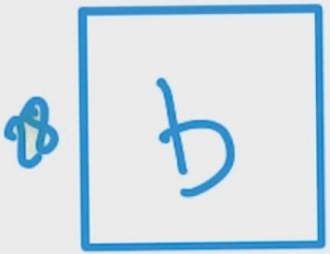
10 classes
'A', 'B', ... 'J'

NUMBER OF PARAMETERS ?

Source: https://www.udacity.com/course/deep-learning--ud730

LINEAR MODEL COMPLEXITY



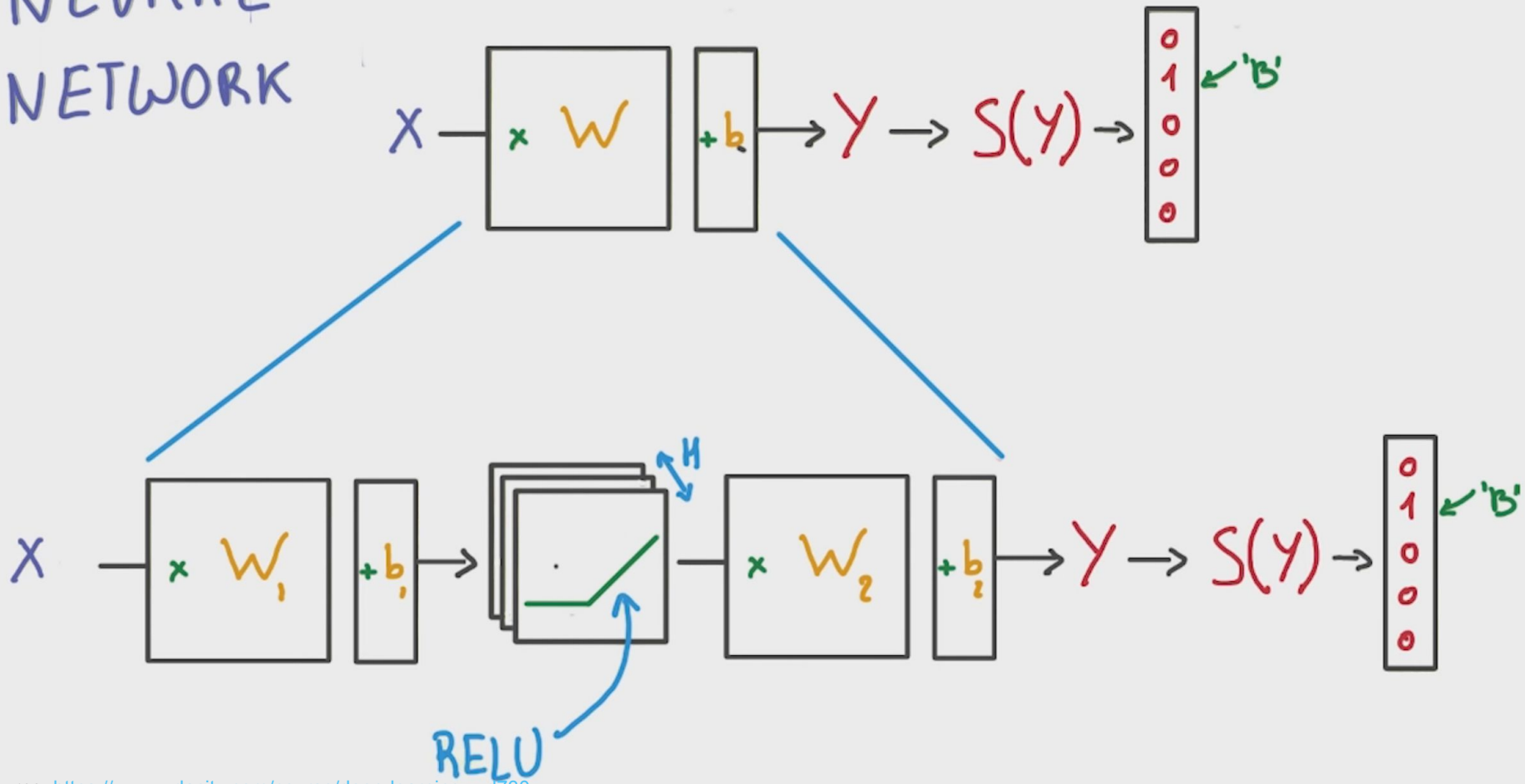


NUMBER OF PARAMETERS?

7850 = 28x28x10+10

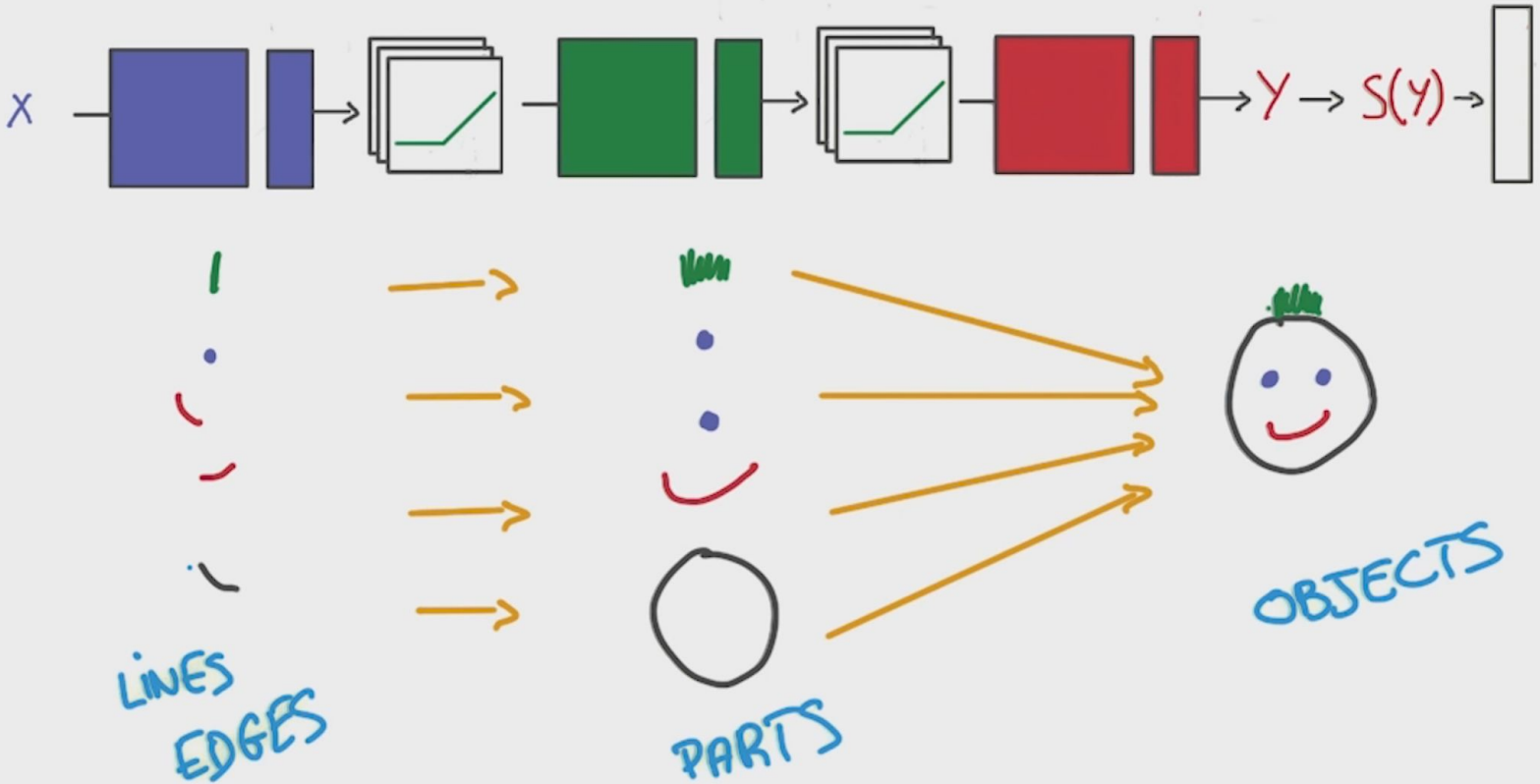
Source: https://www.udacity.com/course/deep-learning--ud730

NEURAL NETWORK



Source: https://www.udacity.com/course/deep-learning--ud730

DEEP NETWORKS



Source: https://www.udacity.com/course/deep-learning--ud730

Agenda

1. What is TensorFlow?

2. Why would you use it?

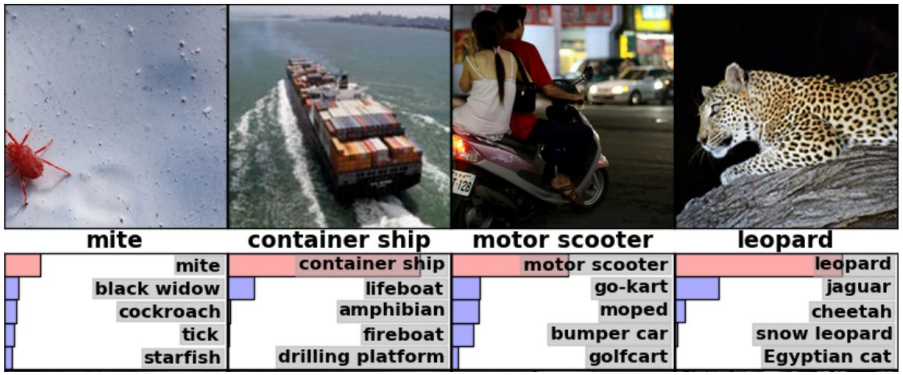
3. How does it work? + Demo

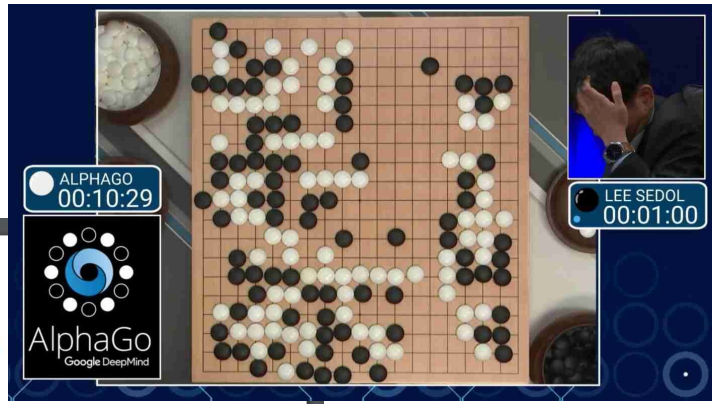
4. CloudML (alpha) discussion

Why would you use NN / Deep Learning?

- Neural Networks (NNs) are **universal function approximators** that work very well with **huge datasets**
- NNs / deep networks do **unsupervised feature learning**

- Track record, being SotA in:
  - image classification,
  - language processing,
  - speech recognition,
  - ...





Why does deep and cheap learning work so well?

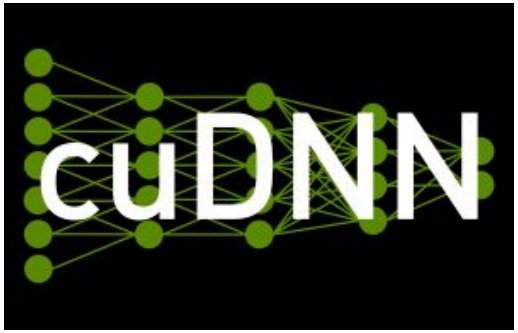
Henry W. Lin and Max Tegmark
Dept. of Physics, Harvard University, Cambridge, MA 02138 and
Dept. of Physics & MIT Kavli Institute, Massachusetts Institute of Technology, Cambridge, MA 02139

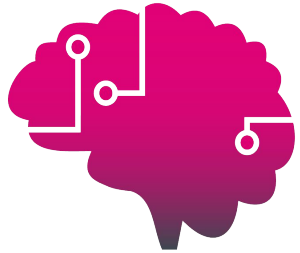
(Dated: August 31, 2016)

Why TensorFlow?

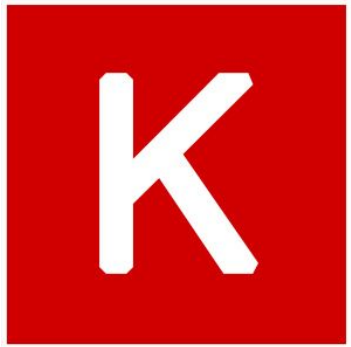
There are a lot of alternatives:

- Torch
- Caffe
- Theano (Keras, Lasagne)
- CuDNN
- Mxnet
- DSSTNE
- DL4J
- DIANNE
- Etc.

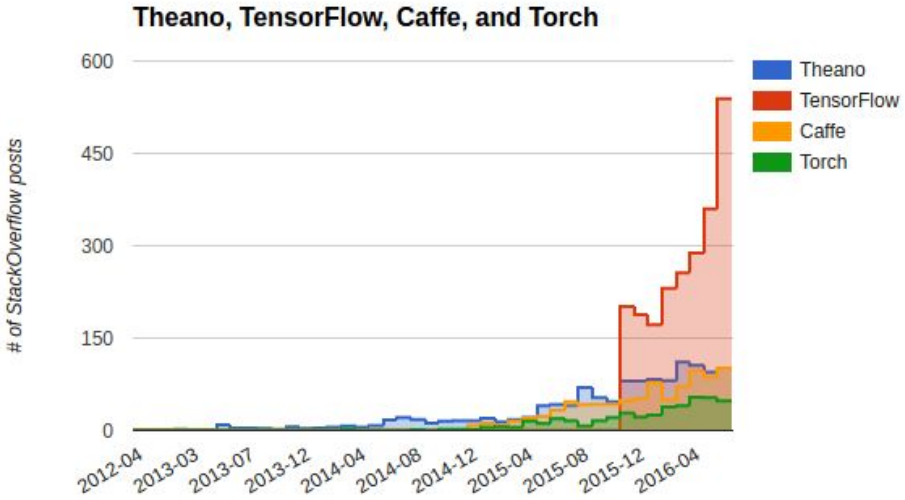


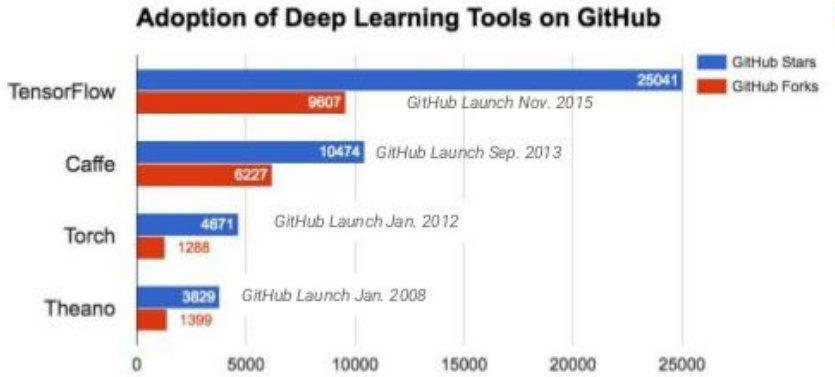


theano



TensorFlow has the largest community





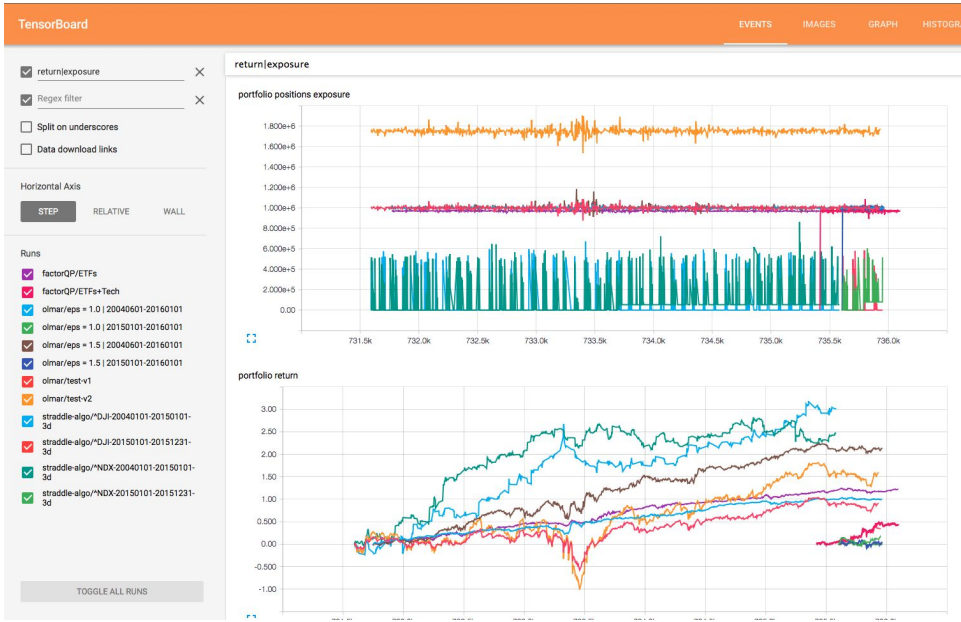
Sources: http://deliprao.com/archives/168
http://www.slideshare.net/JenAman/large-scale-deep-learning-with-tensorflow

TensorFlow is very portable/scalable

Runs on CPUs, GPUs, TPUs over one or more machines, but also on phones(android+iOS) and raspberry pi's...

TensorFlow is more than an R&D project

- Specific functionalities for deployment (TF Serving / CloudML)
- Easier/more documentation (for more general public)
- Included visualization tool (Tensorboard)
- Simplified interfaces like SKFlow



Agenda

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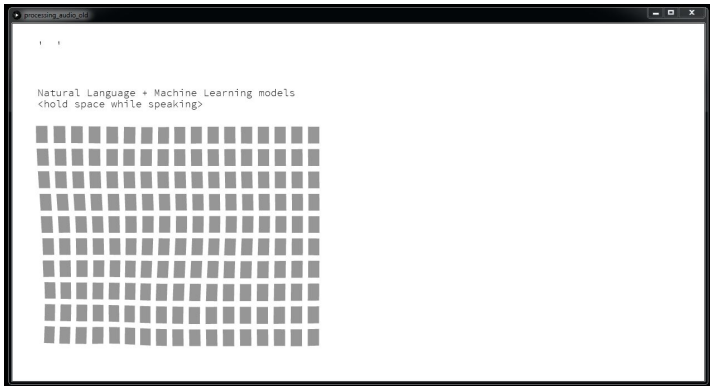
How does it work?

Number Recognition \w TF explained (in notebook)

```
# Launch the graph
with tf.Session() as sess:
    sess.run(init)

    # Training cycle
    for epoch in range(training_epochs):
        avg_cost = 0.
        total_batch = int(mnist.train.num_examples/batch_size)
        # Loop over all batches
        for i in range(total_batch):
            batch_xs, batch_ys = mnist.train.next_batch(batch_size)
            # Fit training using batch data
            _, c = sess.run([optimizer, cost], feed_dict={x: batch_xs,
                                                          y: batch_ys})
            # Compute average loss
            avg_cost += c / total_batch
        # Display logs per epoch step
        if (epoch+1) % display_step == 0:
            print "Epoch:", '%04d' % (epoch+1), "cost=", "{:.9f}".format(avg_cost)
```

Speech classification (demo)



Tensorboard notebook:
here

Great starting point:
https://github.com/tensorflow/models

Do It Yourself! (in Datalab)

Do It Yourself:

1) Open Cloud Shell
2) Paste these commands:

```
gcloud container clusters create datalab-cluster --machine-type n1-standard-4
--num-nodes 1 --zone europe-west1-d

kubectl run datalab --image=gcr.io/cloud-datalab/datalab:mlbeta2 --port=8080

kubectl expose deployment datalab --type="LoadBalancer"

kubectl get service datalab
```

3) Enter the returned EXTERNAL-IP+":8080" in your browser

Agenda

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CloudML

MACHINE LEARNING FEATURES

Machine Learning on any data, any size

2

Integrated

Google services are designed to work together. It works with Cloud Dataflow for feature processing, Cloud Storage for data storage and Cloud Datalab for model creation.

1

Managed service

Focus on model development and prediction without worrying about the infrastructure. Managed service automates all resource provisioning and monitoring.

1

Scalable Platform

Build models of any data size or type using managed distributed training infrastructure. Accelerate model creation, by training across any number of nodes, that can optionally be powered by GPUs.

2

Notebook Developer Experience

Create and analyze models using the familiar Jupyter notebook development experience, with integration to Cloud Datalab.

3

Portable Models

Use the open source TensorFlow SDK to train models locally on sample data sets and use the Google Cloud Platform for training at scale. In future phases, models trained using Cloud Machine Learning can be downloaded for local execution.

Further reading

- Curated list of TF resources: https://github.com/jtoy/awesome-tensorflow
- Models implemented in TF: https://github.com/tensorflow/models
- Slides “TF tricks of the trade”: https://drive.google.com/open?id=x_...
- Slides “TF and Deep Learning without a PhD”: https://docs.google.com/presentation/d/...
- Blogpost “DL with spark and TF”: https://databricks.com/blog/...
- The official documentation: https://www.tensorflow.org/versions/r0.10/...

Join: https://www.meetup.com/TensorFlow-Belgium

Thank you