Big Data Technology

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Neural Network in Your Browser

https://playground.tensorflow.org

Outline

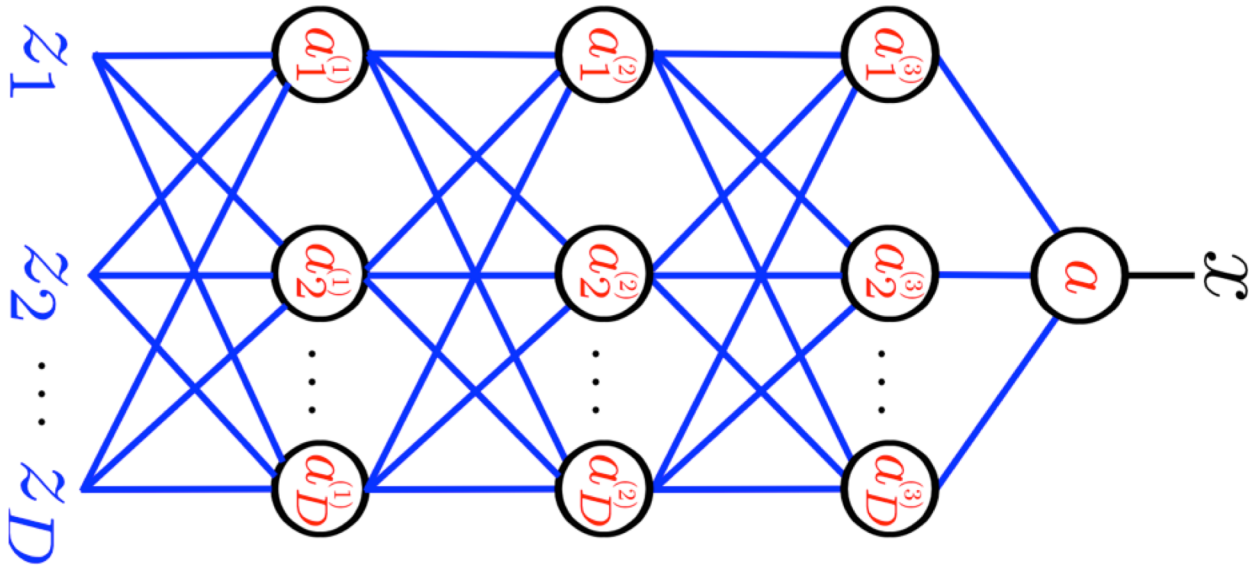
- **Logistics**
- **Summary and Review Previous Sections**
- **TensorFlow Playground**
- **Convolution Neural Network**

Stochastic Gradient Descent (SGD)

Loop:

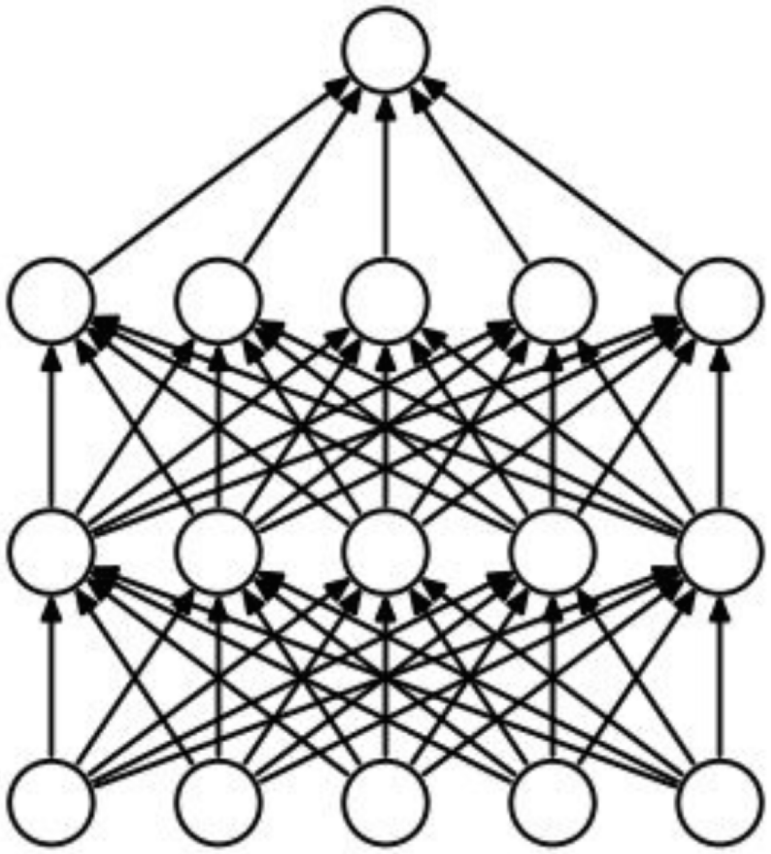
1. **Sample a batch of data with their labels**
2. **Forward Propagate it through the graph, calculate the error**
3. **Backpropagate to calculate the gradients**
4. **Update the parameters (weights) using the gradient**

$$W_k = W_{k-1} - \epsilon \frac{\partial E(W)}{\partial W}$$

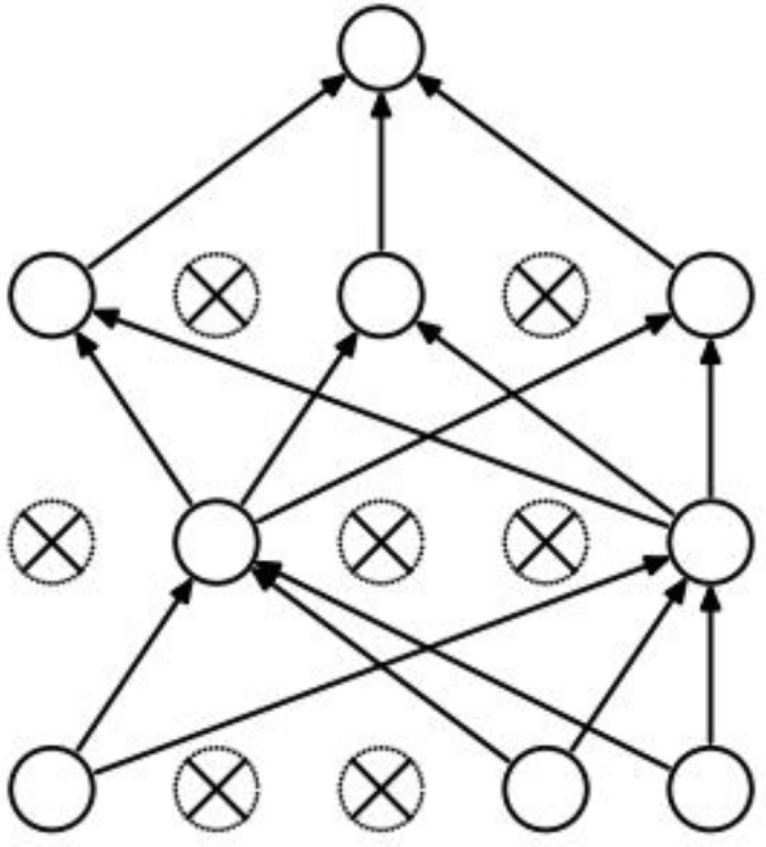


Dropout

Randomly set some neurons to zero in the forward pass

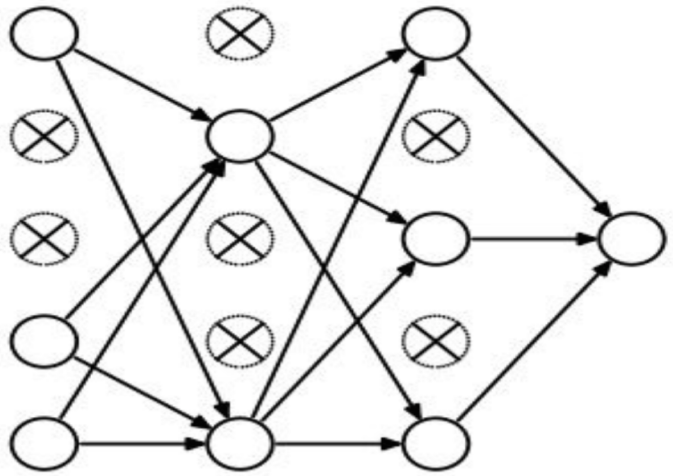


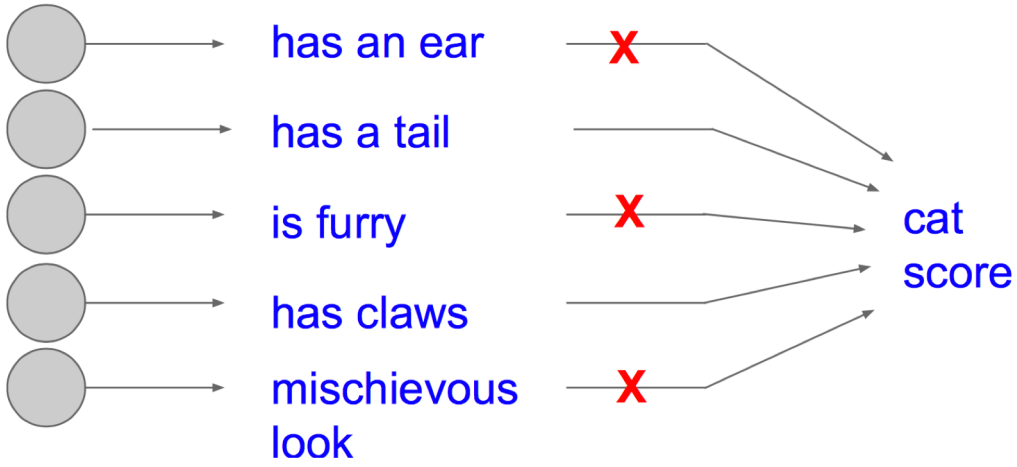
After Applying Dropout



Srivastava et al., 2014, https://www.cs.toronto.edu/~hinton/absps/JMLRdropout.pdf

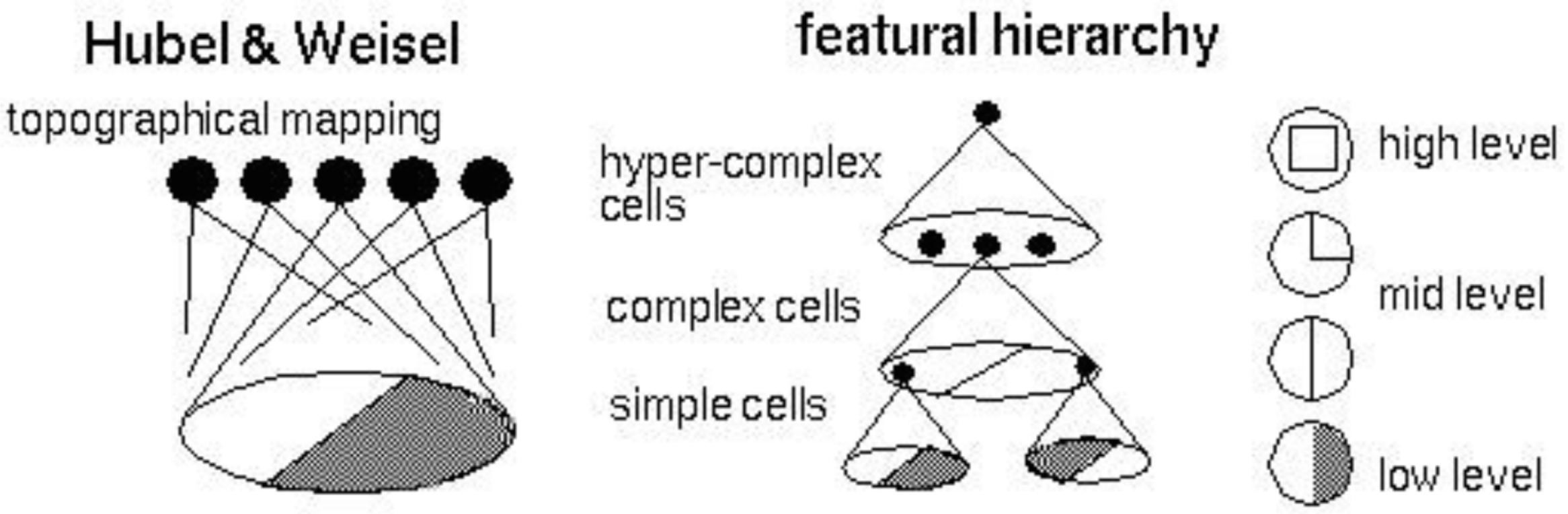
Dropout





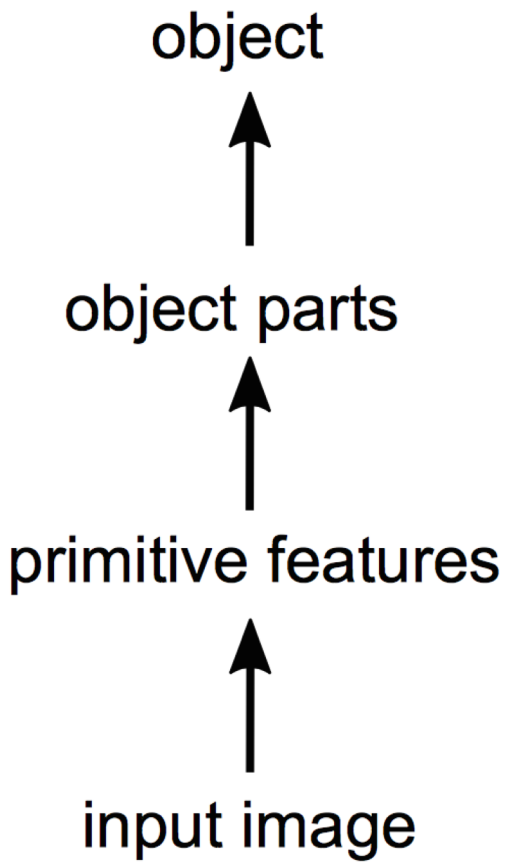
Forces the network to have a redundant representation

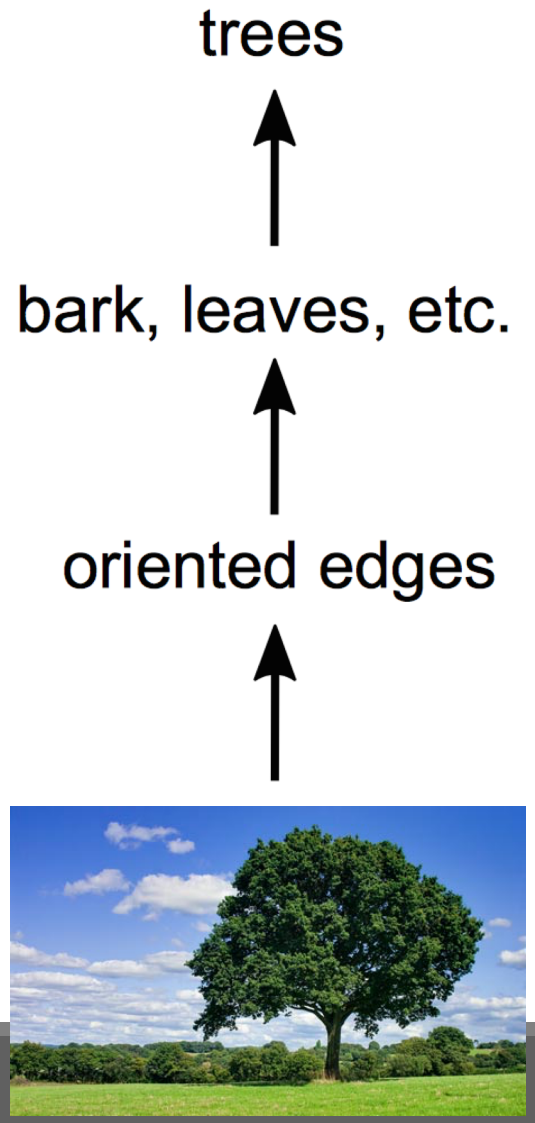
Vision: Hierarchical Organization (Year: 1962)

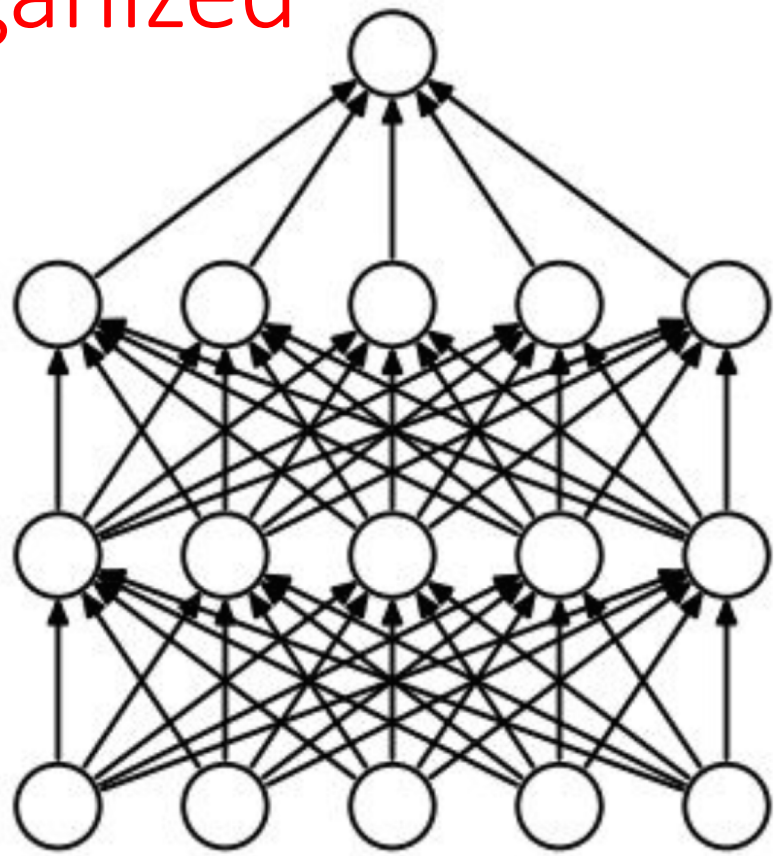


Why use hierarchical multi-layered models?

Biological vision is hierarchically organized







What's wrong with standard neural networks?

Hard to Train

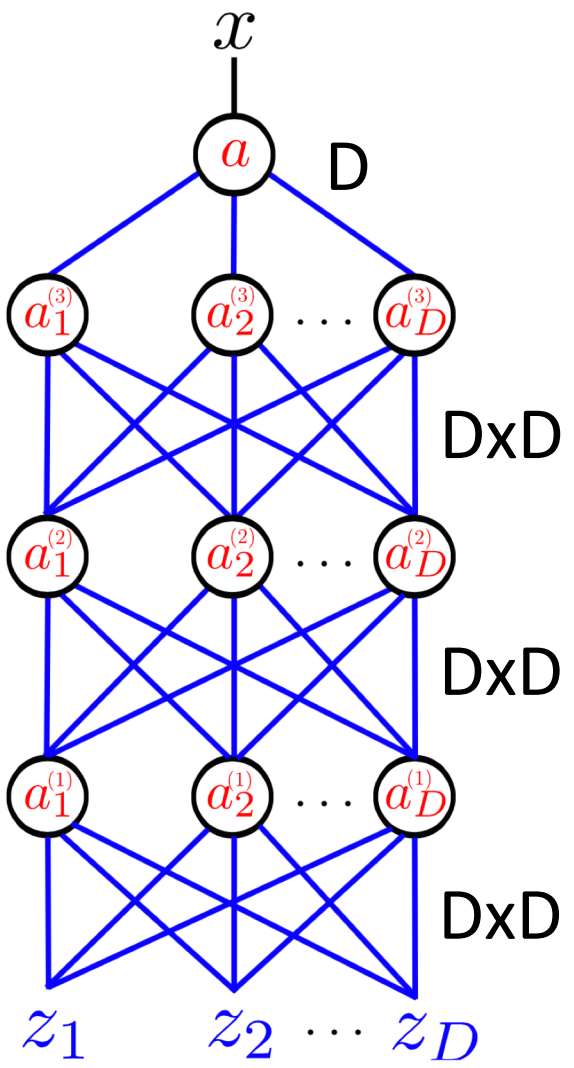
How many parameters does this network have?

Number of Parameters = 3 x (DxD) + D

For a small D = 32 x 32 = 1024 MNIST image:

Number of Parameters = 3 x (1024x1024) + 1024

~ 3×10^6



Architecture of LeNet-5, Convolution Neural Network

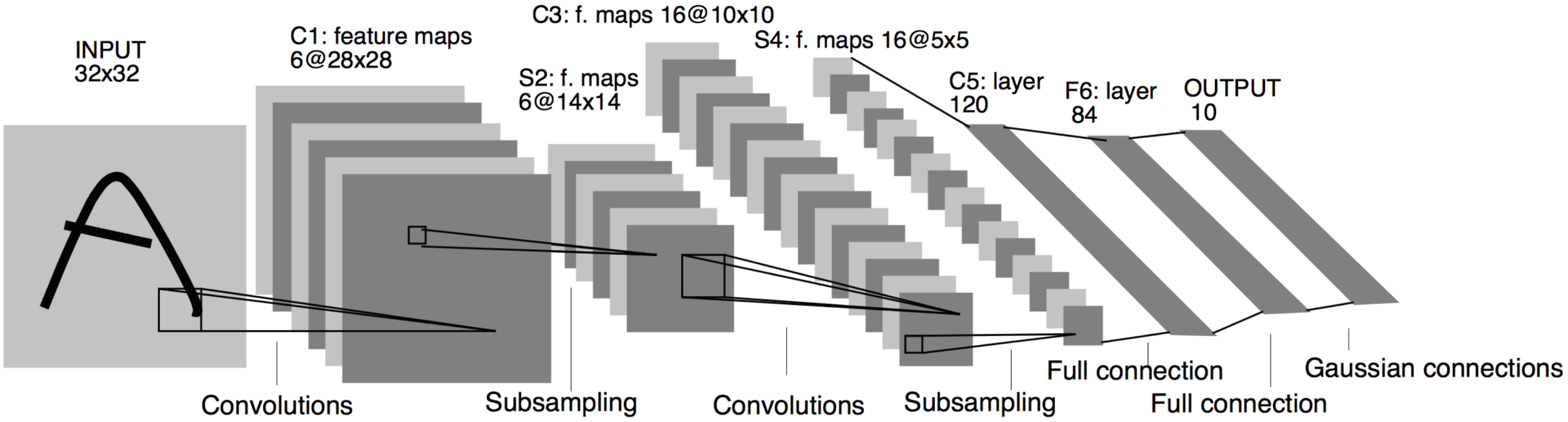
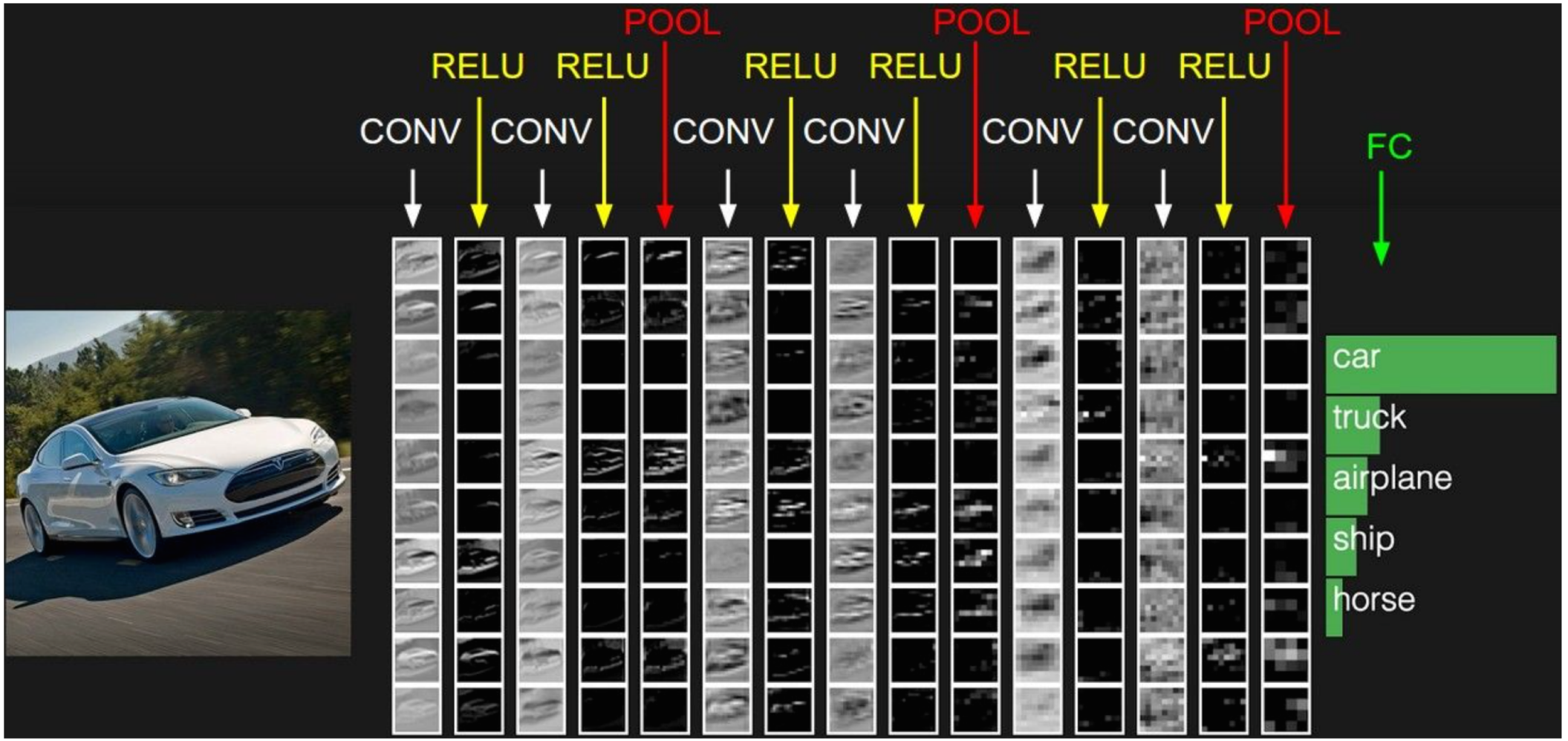


Fig. 2. Architecture of LeNet-5, a Convolutional Neural Network, here for digits recognition. Each plane is a feature map, i.e. a set of units whose weights are constrained to be identical.

Proc. Of the IEEE, November 1998, "Gradient-Based Learning Applied to Document Recognition"


POOL
POOL
POOL
RELU
RELU
RELU
RELU
RELU
RELU
CONV
CONV
CONV
CONV
CONV
CONV
FC
car
truck
airplane
ship
horse

Review: What is convolution?

- Convolution is an important operation from signal processing
- A convolution is an integral that expresses the amount of overlap of one function as it is shifted over another function .

$$f * g = \int_{-\infty}^{\infty} f(\tau)\, g(t-\tau)\, d\tau = \int_{-\infty}^{\infty} g(\tau)\, f(t-\tau)\, d\tau$$

- 2 Dimensional Discrete Function (Image)

$$f[x,y] * g[x,y] = \sum_{n_1=-\infty}^{\infty} \sum_{n_2=-\infty}^{\infty} f[n_1,n_2] \cdot g[x-n_1, y-n_2]$$