Neural Networks

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01

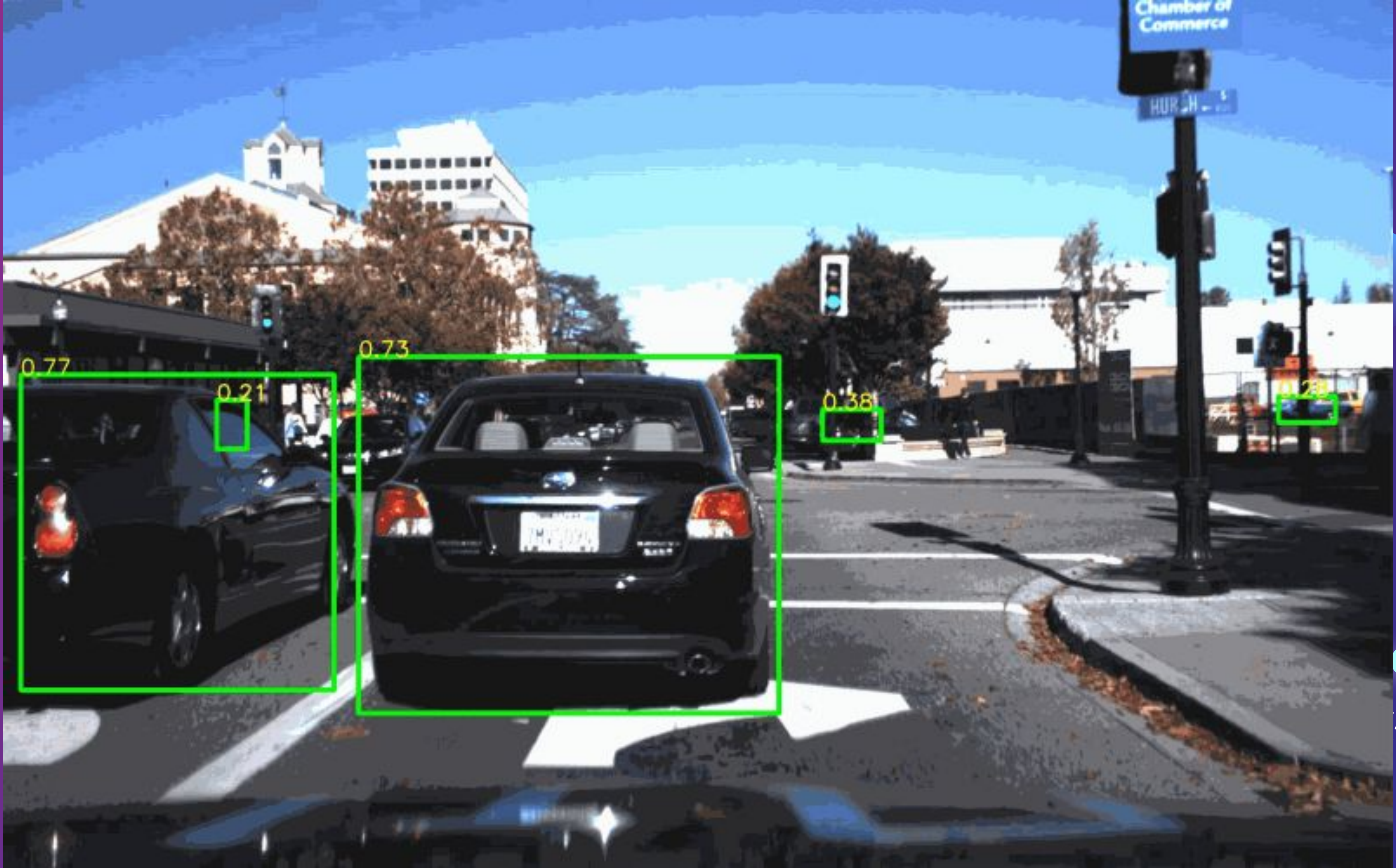
What are Neural Networks and Deep Learning

Machine learning gives computers the ability to learn without being explicitly programmed

—Arthur Samuel (1959)

Create systems to play at super human level

Former world champion of Go defeated by AlphaGo in 2016


Chamber of Commerce
HURCH
0.77
0.21
0.73
0.38
0.28

Save lives

Predicting protein structure

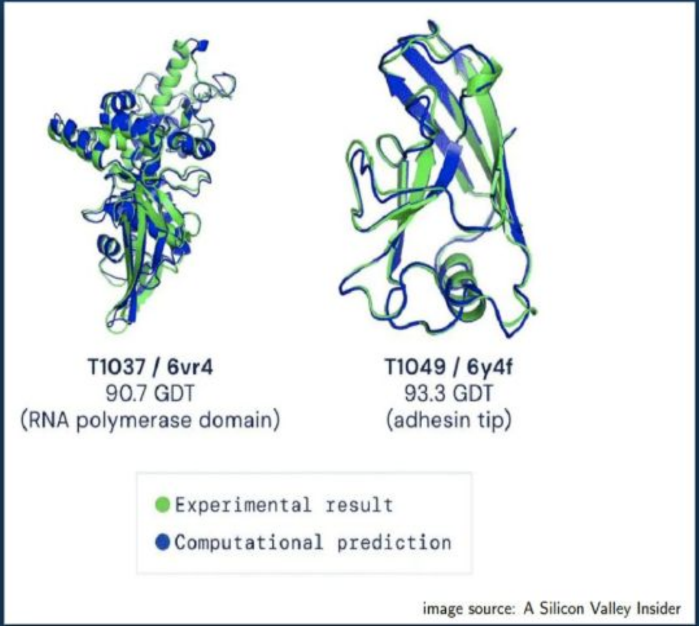


image source: A Silicon Valley Insider

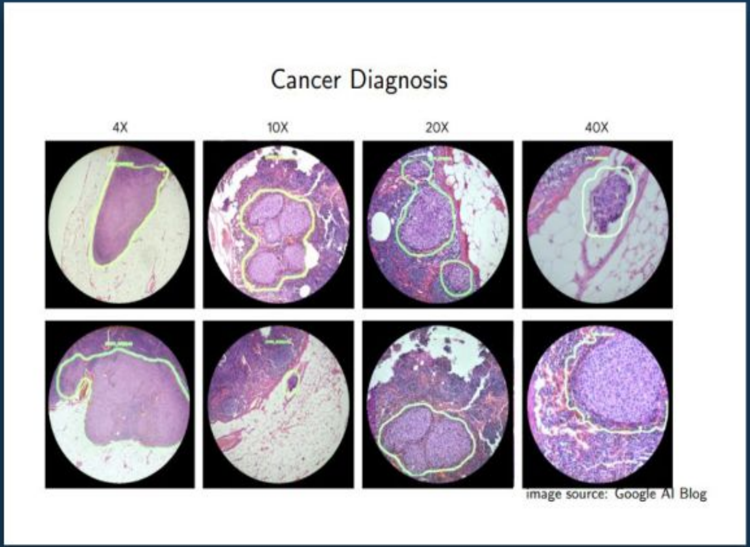
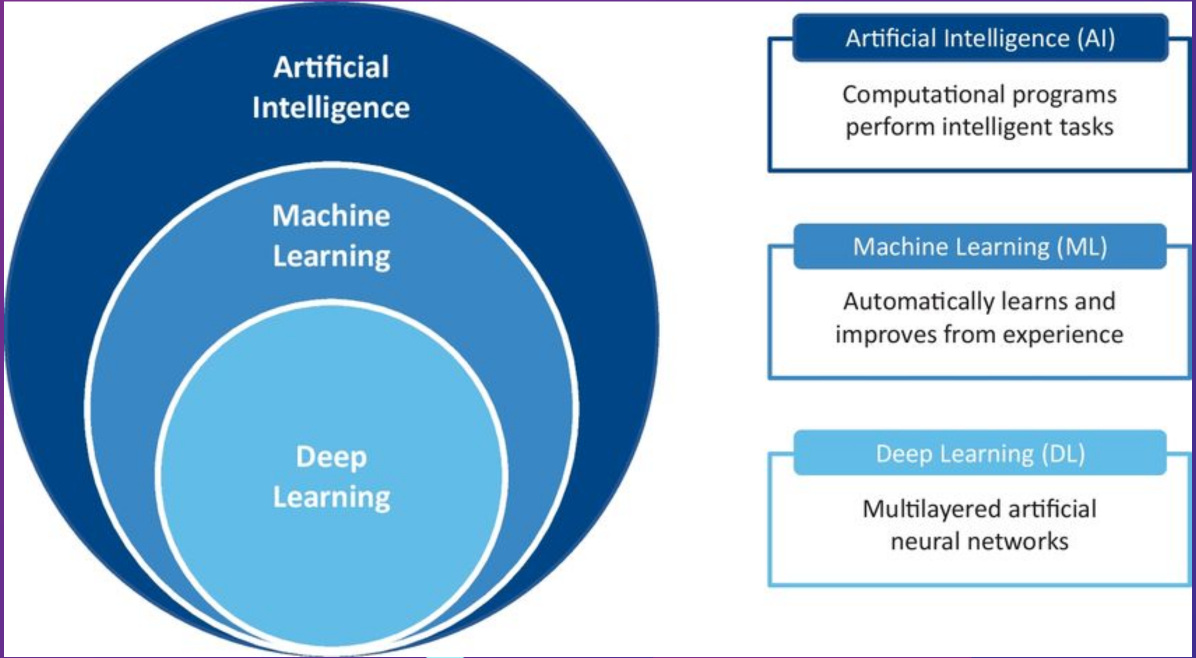


image source: Google AI Blog

Deep Learning



Artificial Intelligence (AI)

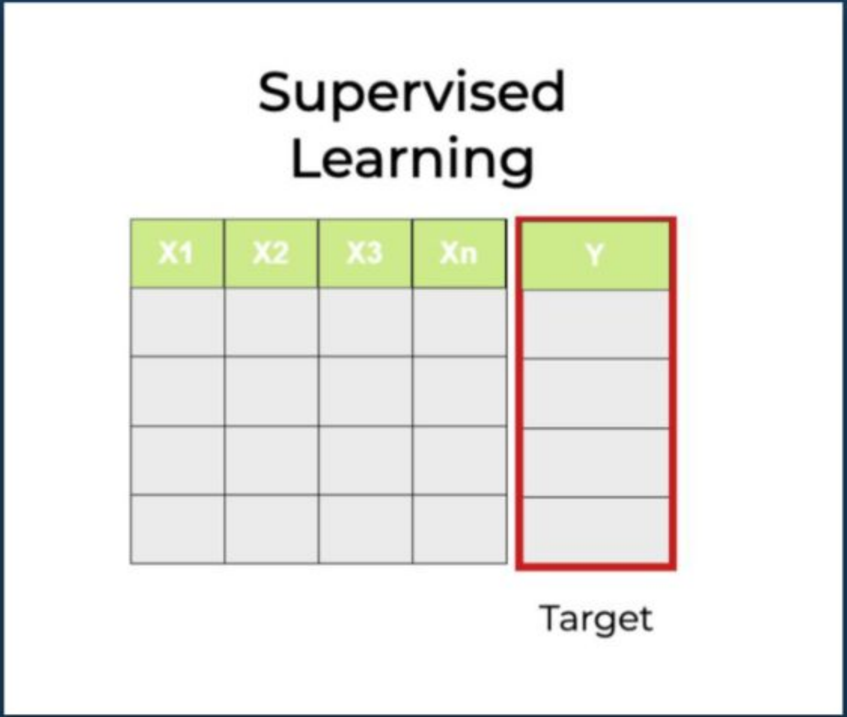
Computational programs perform intelligent tasks

Machine Learning (ML)

Automatically learns and improves from experience

Deep Learning (DL)

Multilayered artificial neural networks



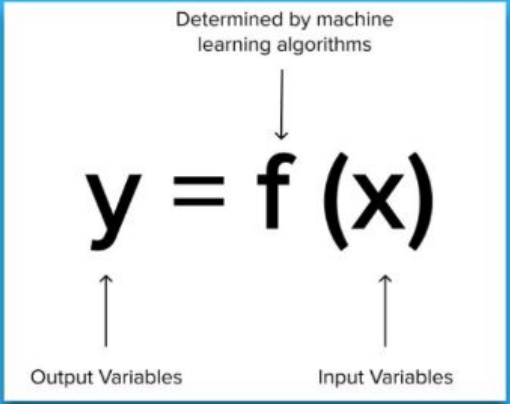
Supervised Learning

X1	X2	X3	Xn	Y

Target

In supervised learning we have The data X consisting of different features and the label y what we want to predict

Machine learning models tries to learn the function to transform X into y



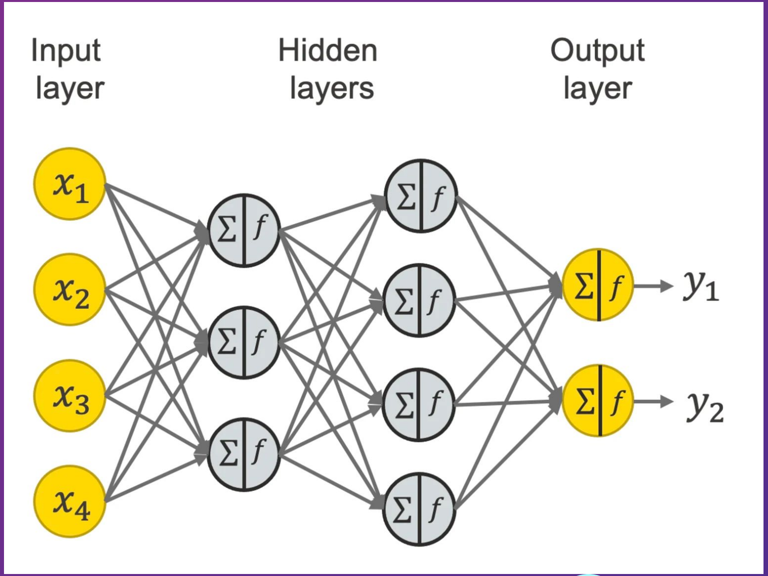
Determined by machine learning algorithms

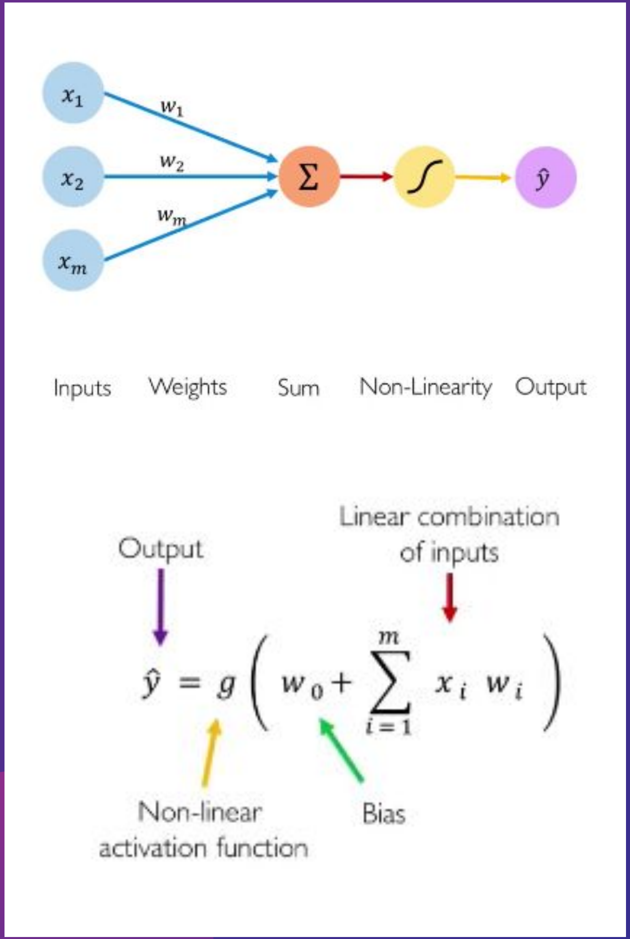
$$y = f(x)$$

Output Variables

Input Variables

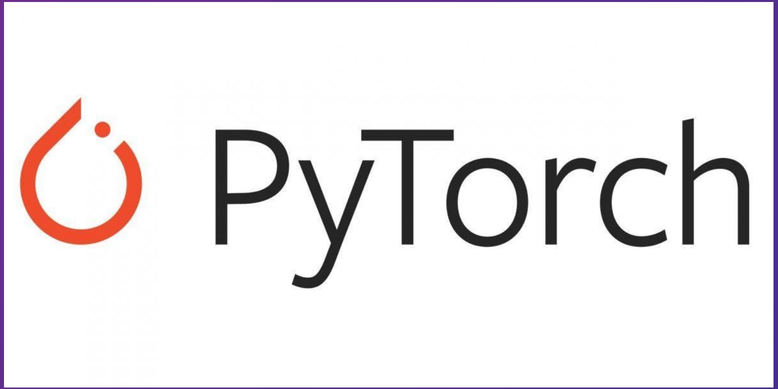
The Math


Input layer
Hidden layers
Output layer
x_1
x_2
x_3
x_4
Σ f
y_1
y_2


x_1
x_2
x_m
w_1
w_2
w_m
Σ
$\hat{y}$
Inputs
Weights
Sum
Non-Linearity
Output
Output
Linear combination of inputs
$\hat{y} = g\left(w_0 + \sum_{i=1}^{m} x_i w_i\right)$
Non-linear activation function
Bias

PyTorch

- Is an industry standard library for deep learning
- Includes all you tools you need to build, train and run a deep learning model
- Alternatives: Tensorflow, JAX



Let’s look at the code

Do Task 1: Create a Neural Network

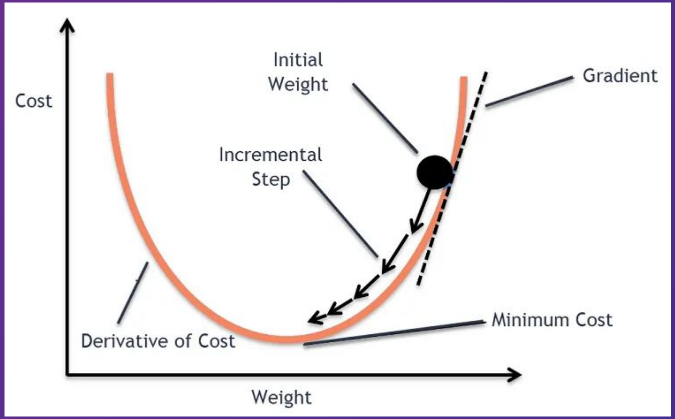
02

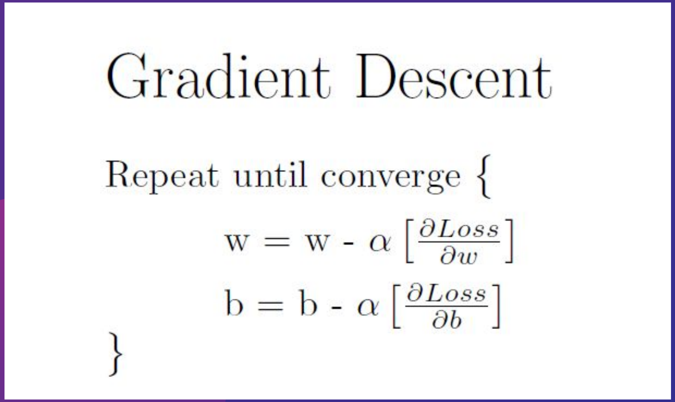
Training

Gradient Descent

- Used during training to find out how to adjust the network learnable parameters, AKA how it learns

- Minimize the loss function
- Change the weights





Gradient Descent

Repeat until converge {

$$w = w - \alpha \left[\frac{\partial Loss}{\partial w}\right]$$

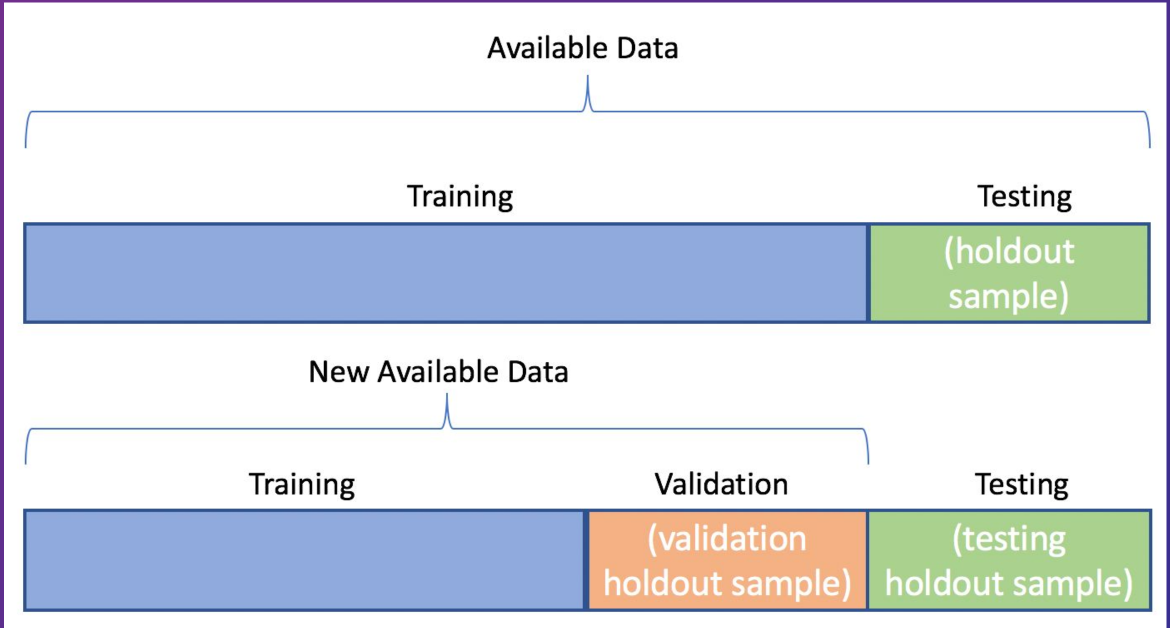
$$b = b - \alpha \left[\frac{\partial Loss}{\partial b}\right]$$

}

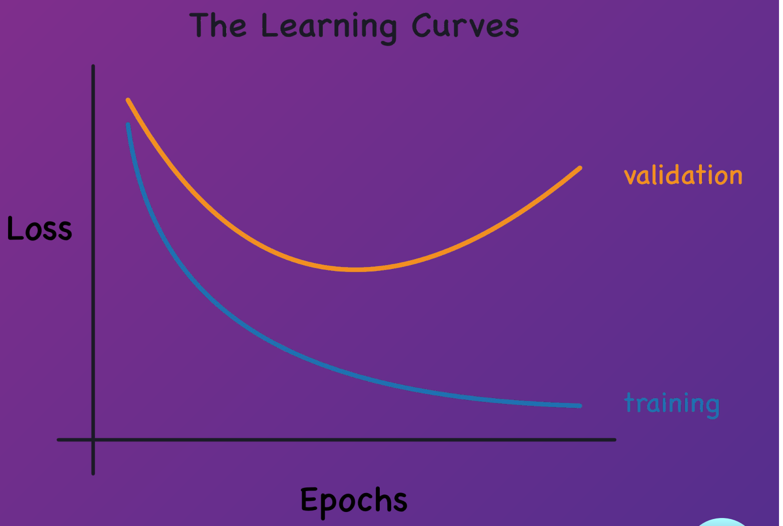
Splitting the dataset

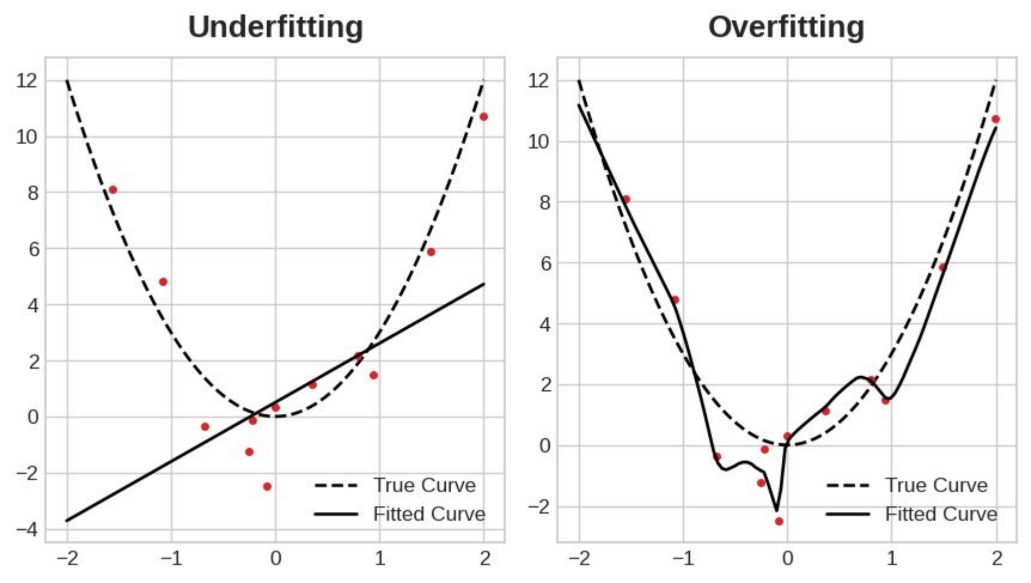
- Want to give the model much data

- Want the model to generalize



Overfitting and Underfitting





Do Task 2: Train your Neural Network

03

BREAK

10 minutes

04

Competition

35 minutes

Summary

- Machine learning & Deep Learning
- Implementing Neural Networks
  - Design networks
  - Do predictions
  - Training
- Evaluating model performance
  - Underfitting and Overfitting
- Improving the performance

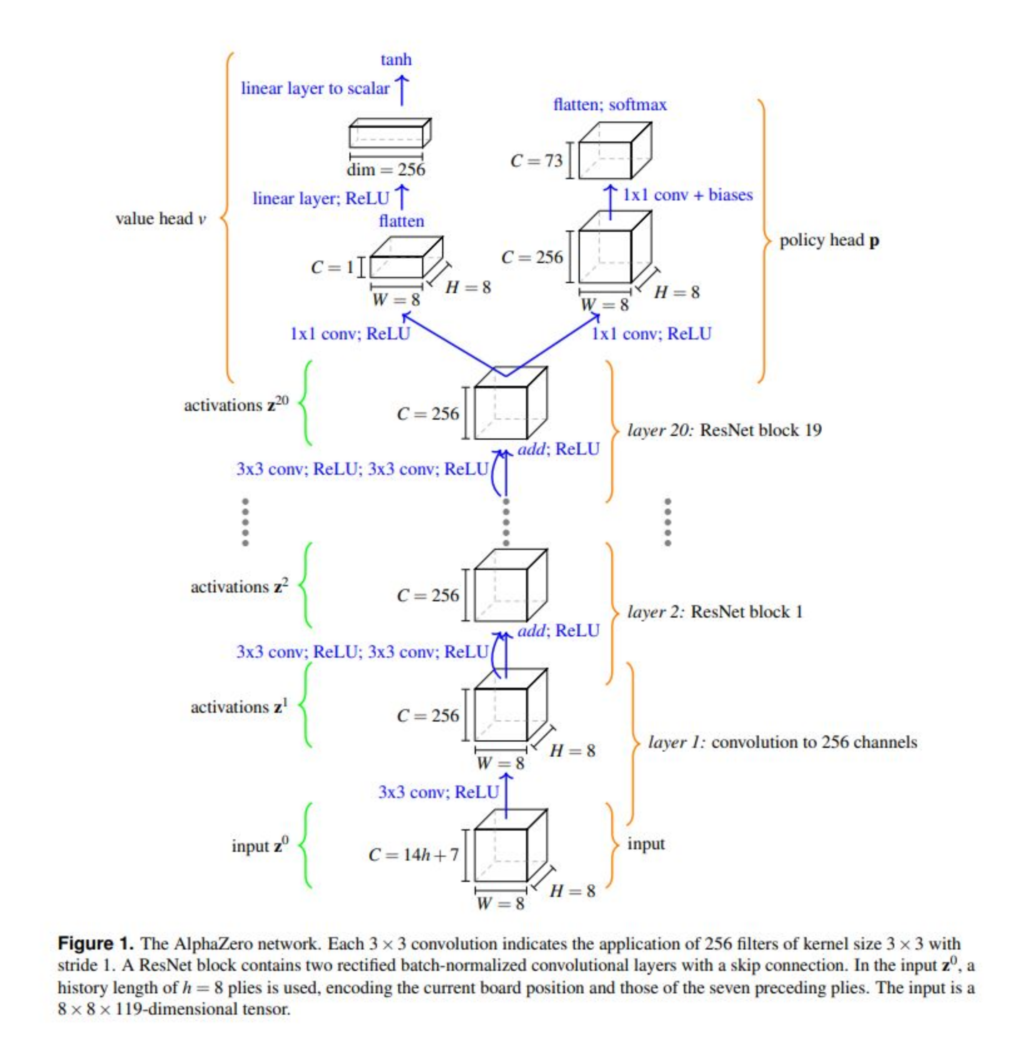


Figure 1. The AlphaZero network. Each 3×3 convolution indicates the application of 256 filters of kernel size 3×3 with stride 1. A ResNet block contains two rectified batch-normalized convolutional layers with a skip connection. In the input $\mathbf{z}^0$, a history length of $h = 8$ plies is used, encoding the current board position and those of the seven preceding plies. The input is a $8 \times 8 \times 119$-dimensional tensor.

Thank you for today!

Next workshop:
Reinforcement Learning

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