

Computer Vision with Embedded Machine Learning

Review of Module 1

A grayscale image of a checkerboard pattern, used to illustrate the concept of a pixel. The image is composed of a grid of squares, each representing a pixel. The squares alternate between dark gray and light gray. Two red rectangles are drawn on the image: a larger one in the lower-left quadrant and a smaller one in the upper-right quadrant. The text "picture element ('pixel')" is written in red above the smaller rectangle.

picture element ("pixel")

57	59	58	67	82
63	66	75	100	124
61	69	89	121	150
71	96	126	145	157

Bit depth: 8 bits

- 0 = black
- 255 = white

0.22	0.23	0.23	0.26	0.32
0.25	0.26	0.29	0.39	0.49
0.24	0.27	0.35	0.47	0.59
0.28	0.38	0.49	0.57	0.62

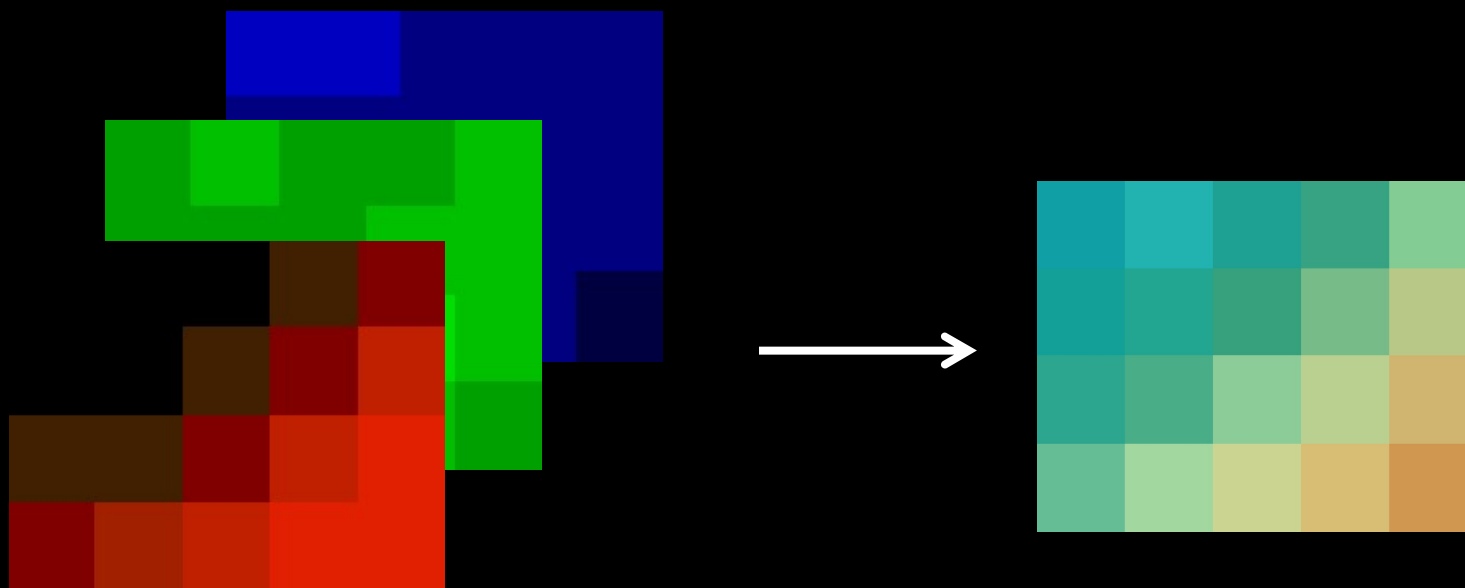
Width = 2290 pixels

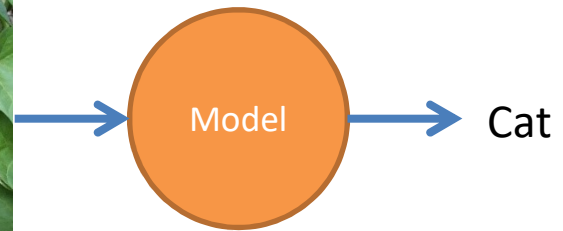
Resolution:
2290 x 1487
(W x H)

Height = 1487 pixels

Size: 2290 x 1487 x 1 = 3,405,230 bytes
W x H x (bit depth in bytes)

© 2021 Edgelmpulse, Inc.



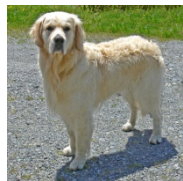


Binary Classification

One-vs-One



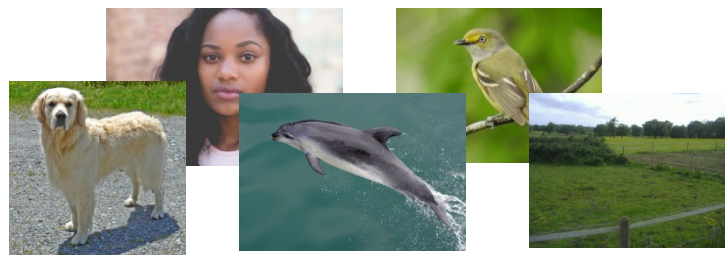
VS.



One-vs-Rest



VS.



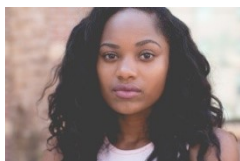
Multiclass Classification



vs.



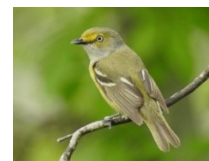
vs.



vs.



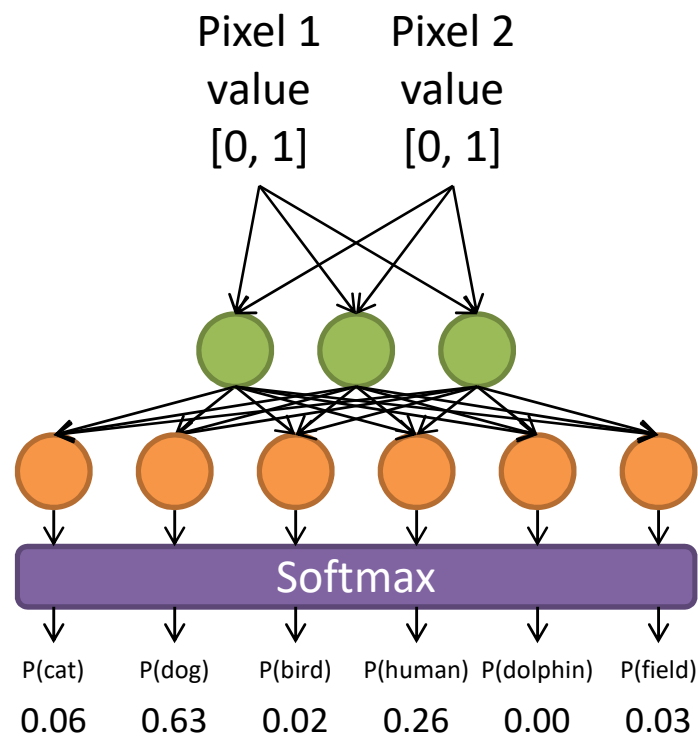
vs.



vs.

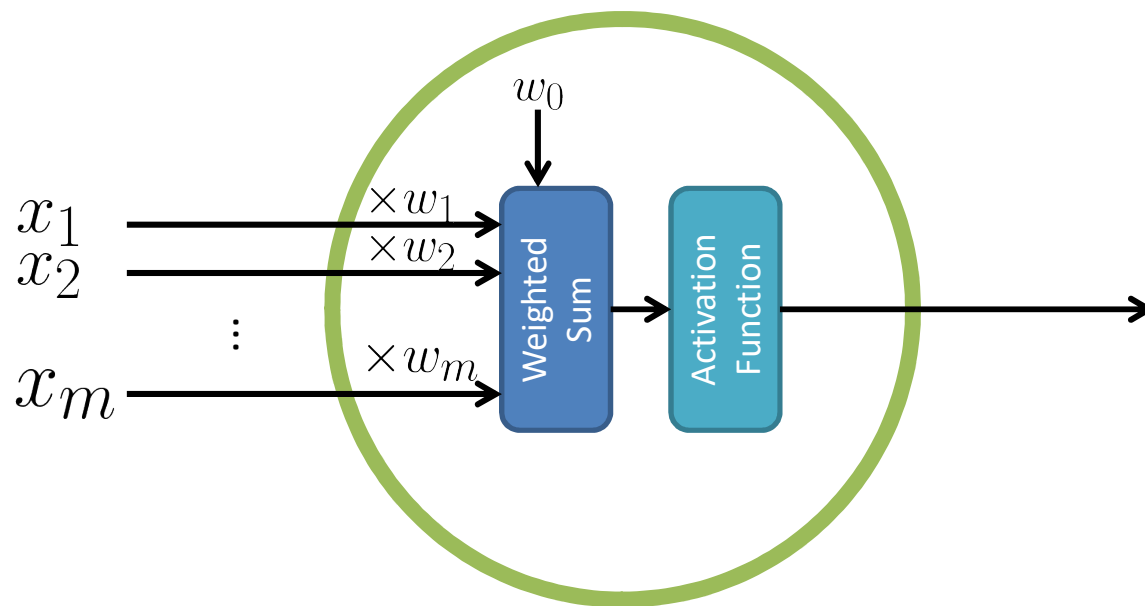


Neural Network (NN)



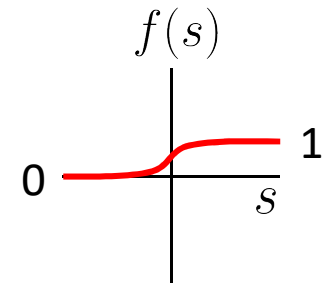
$$P(\text{cat}) + P(\text{dog}) + P(\text{bird}) + P(\text{human}) + P(\text{dolphin}) + P(\text{field}) = 1.0$$

Node (Neuron)

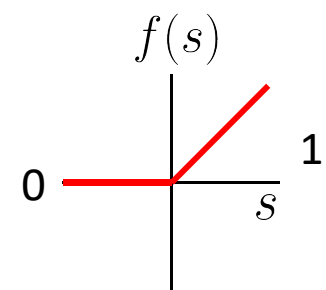


$$f(w_0 + w_1x_1 + w_2x_2 + \dots)$$

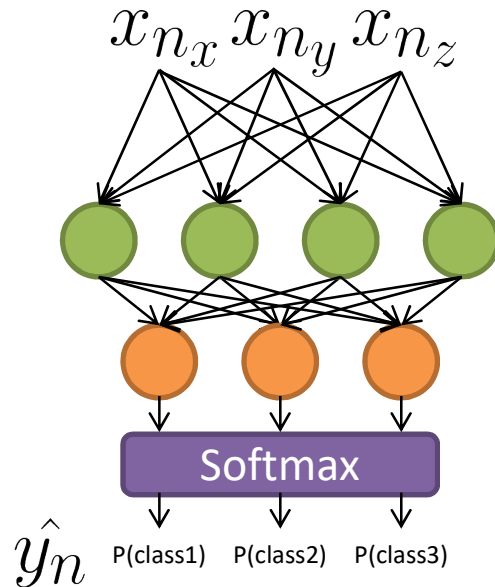
Sigmoid function



ReLU function

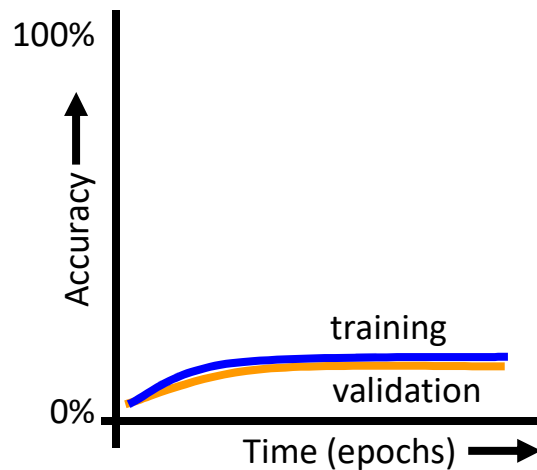


Training

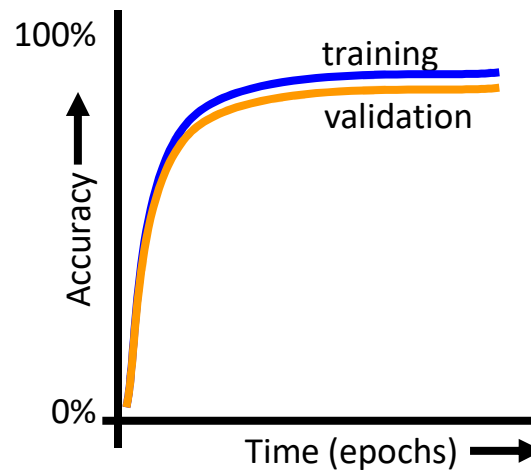


1. Initialize weights with random values
2. Input features from training sample
3. Perform forward pass
4. Calculate loss
5. Perform backpropagation
6. Repeat 2-5 until desired/acceptable performance

Spotting Underfitting and Overfitting

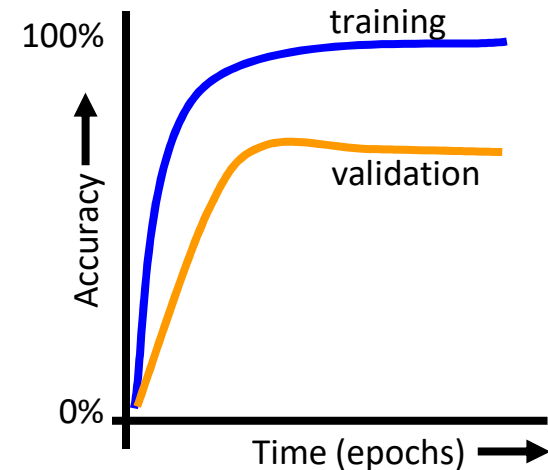


Underfit: Model performs poorly on training and validation data



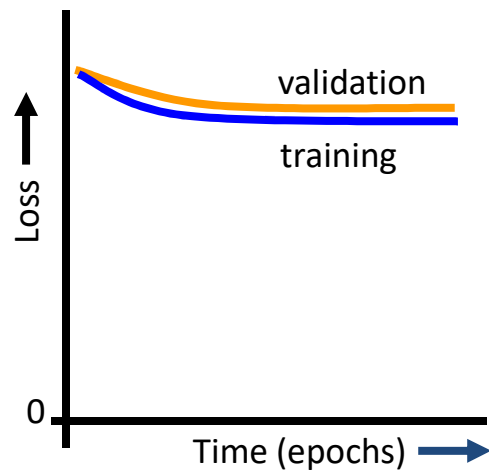
Good fit: Model generalizes well from training to validation data

© 2021 EdgeImpulse, Inc.

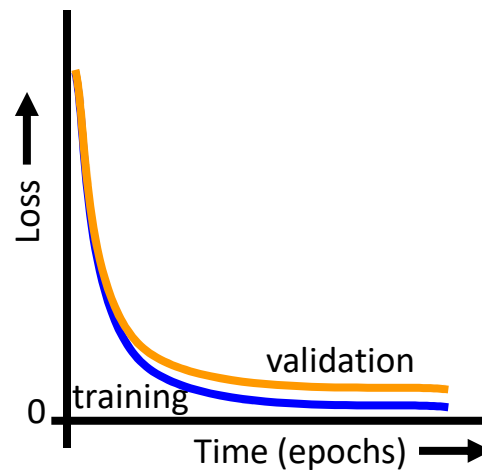


Overfit: Model predicts training data well but fails to generalize to validation data

Spotting Underfitting and Overfitting

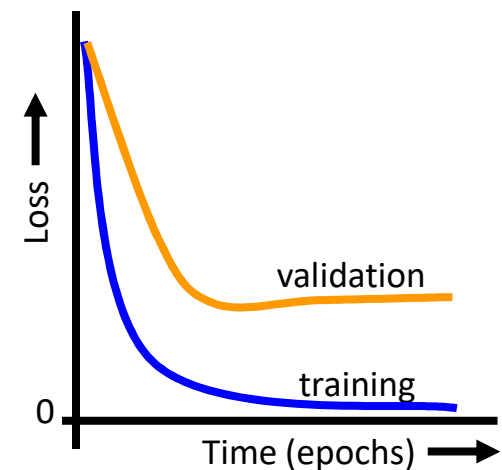


Underfit: Model performs poorly on training and validation data



Good fit: Model generalizes well from training to validation data

© 2021 EdgeImpulse, Inc.



Overfit: Model predicts training data well but fails to generalize to validation data

Confusion Matrix

		Predicted Label			
Actual Label		Cat	Dog	Bird	Human
	Cat	205	10	1	46
	Dog	6	199	0	32
	Bird	9	17	223	34
	Human	21	8	3	186

True Positive (TP): Predicted positive matches actual positive

True Negative (TN): Predicted negative matches actual negative

False Positive (FP) ("Type I Error"): Predicted positive does not match actual negative

False Negative (FN) ("Type II Error"): Predicted negative does not match actual positive