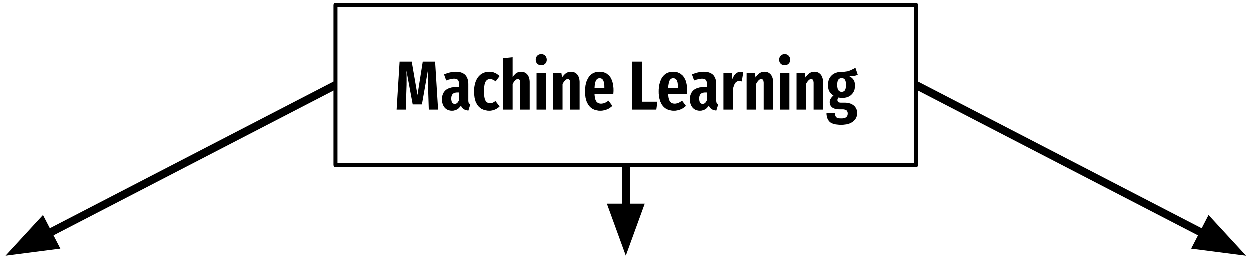
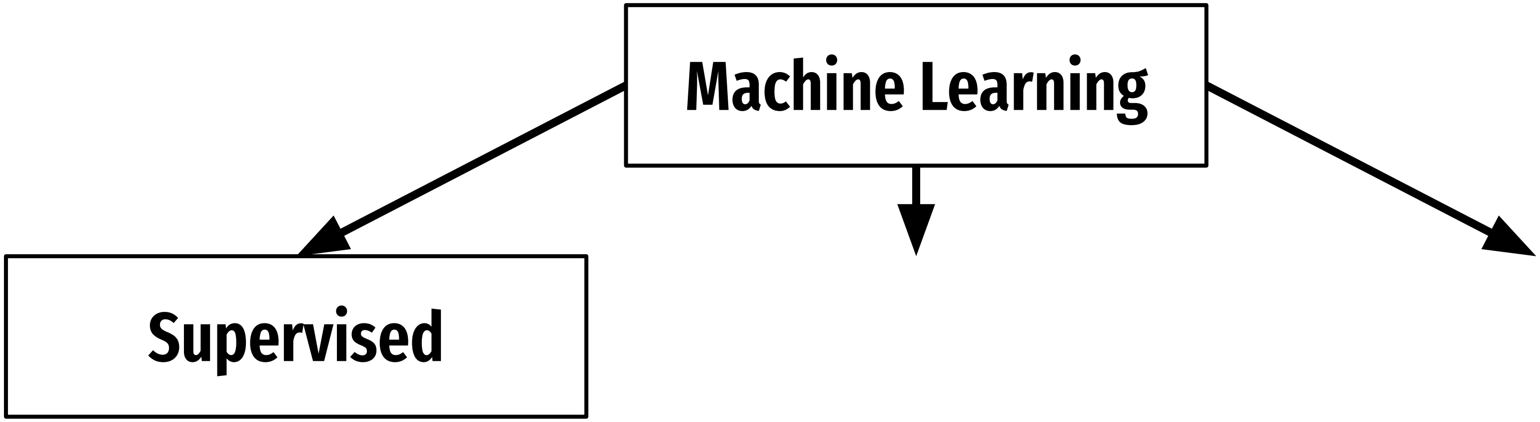
Basics of Machine Learning

Ismaël Lajaaiti

What is Machine Learning?


Machine Learning



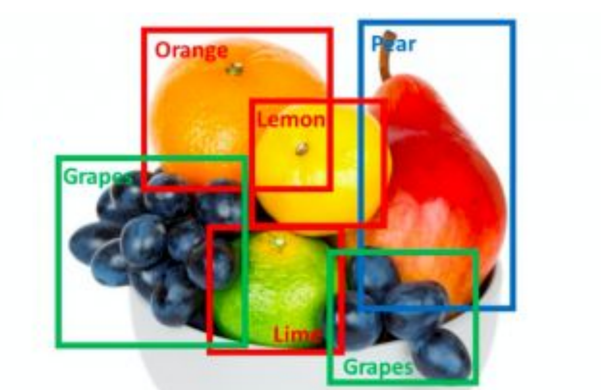
Train algorithm with labeled data

Machine Learning

Supervised

Train algorithm with labeled data

Example: Image classification



Machine Learning

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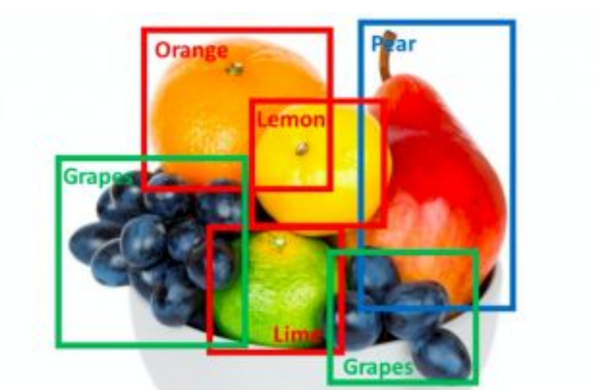

Unsupervised

The algorithm discover the information by itself

Machine Learning

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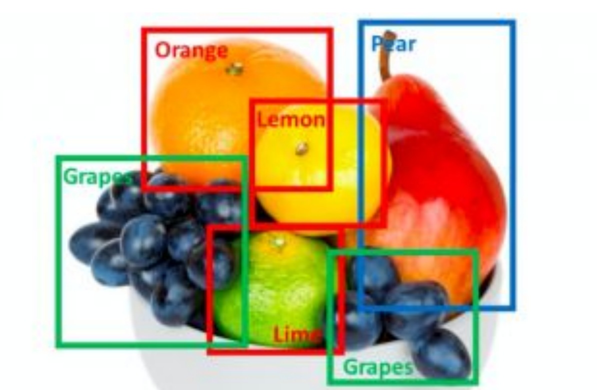

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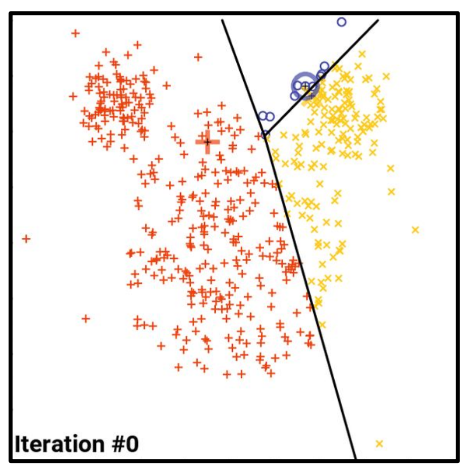
Example: K-means algorithm



Machine Learning

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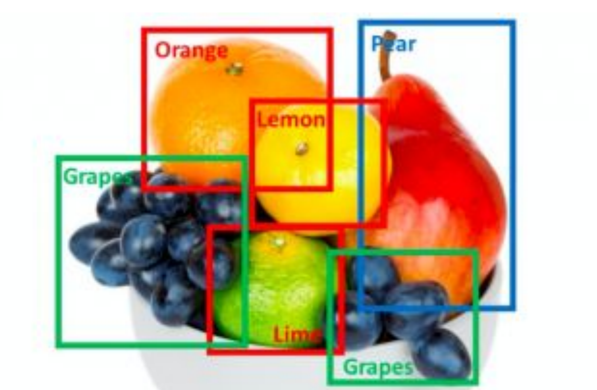

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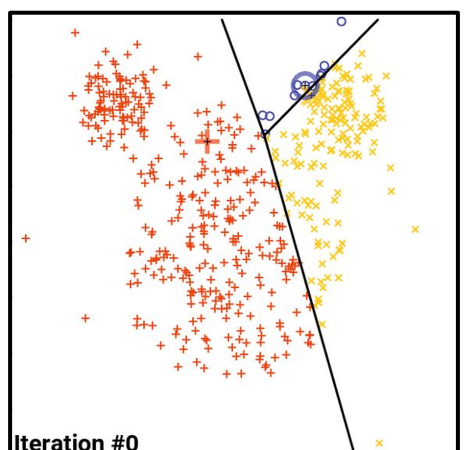

Reinforcement

Simulate game-like situations, the algorithm get reward (for ‘good moves’) and penalties (for ‘bad moves’)

Machine Learning

Supervised

Train algorithm with labeled data

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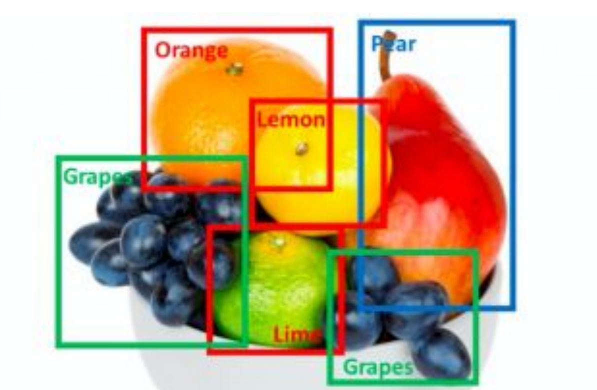

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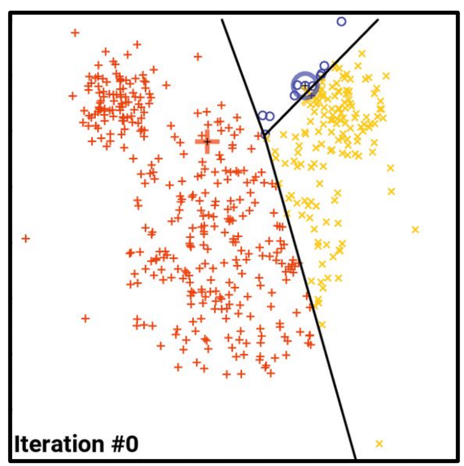

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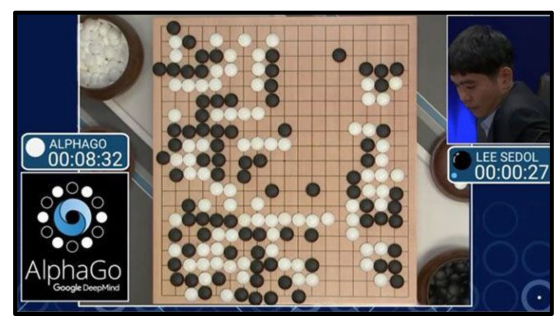
Example: AlphaGo

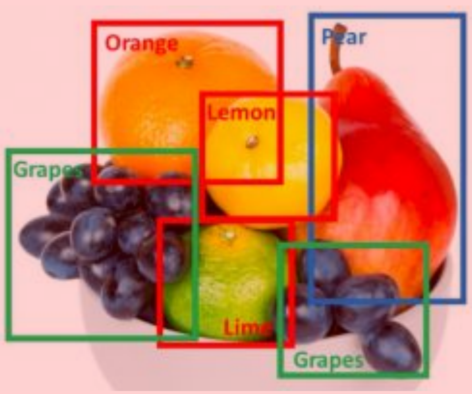


Machine Learning

Supervised

Train algorithm with labeled data

Example: Image classification



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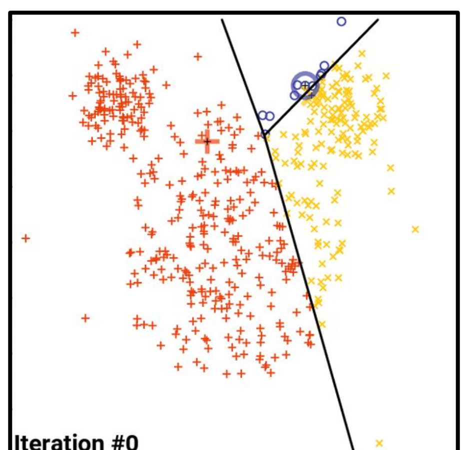

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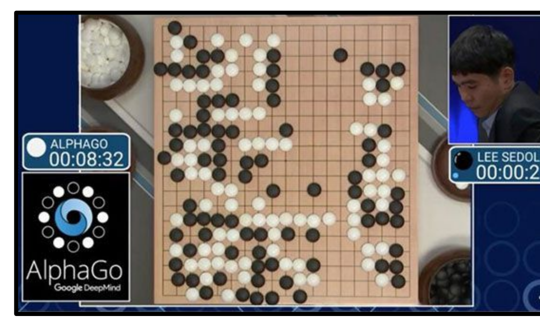

Supervised Learning

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Classification

Predict **categorical** variable

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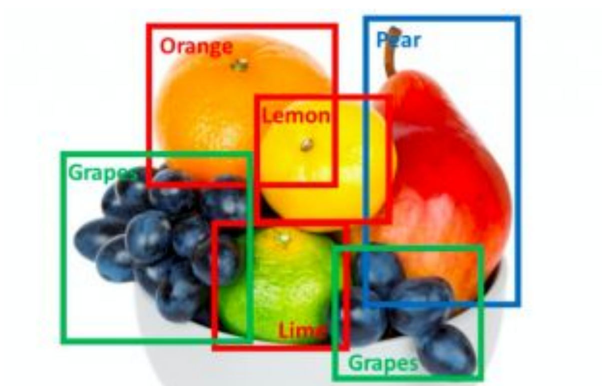
Example: *image classification* -
Output ∈ {“Orange”, “Grapes”, …}



Supervised Learning

Classification

Regression

Predict **categorical** variable

Predict **quantitative** variable

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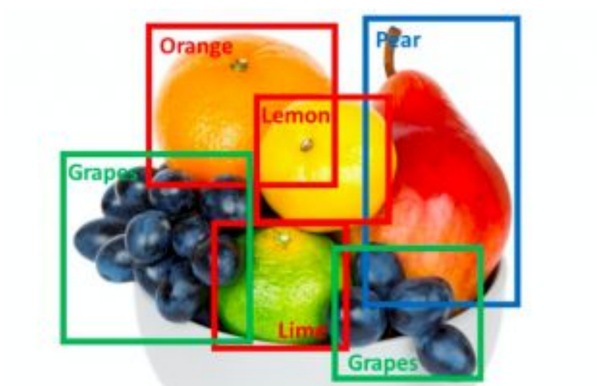

Supervised Learning

Classification

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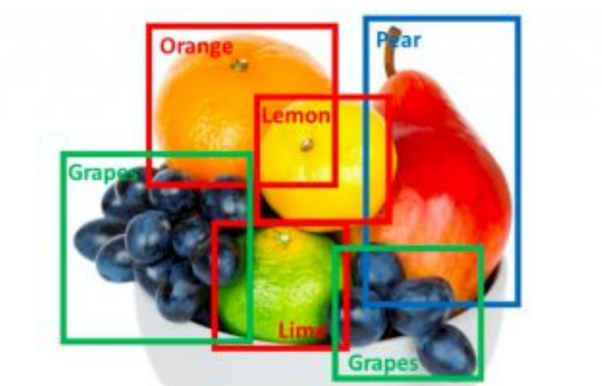
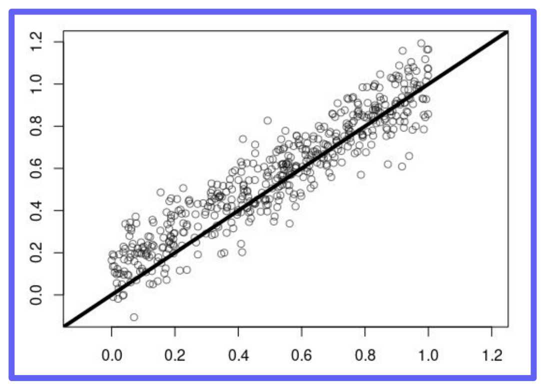


Regression

Predict **quantitative** variable

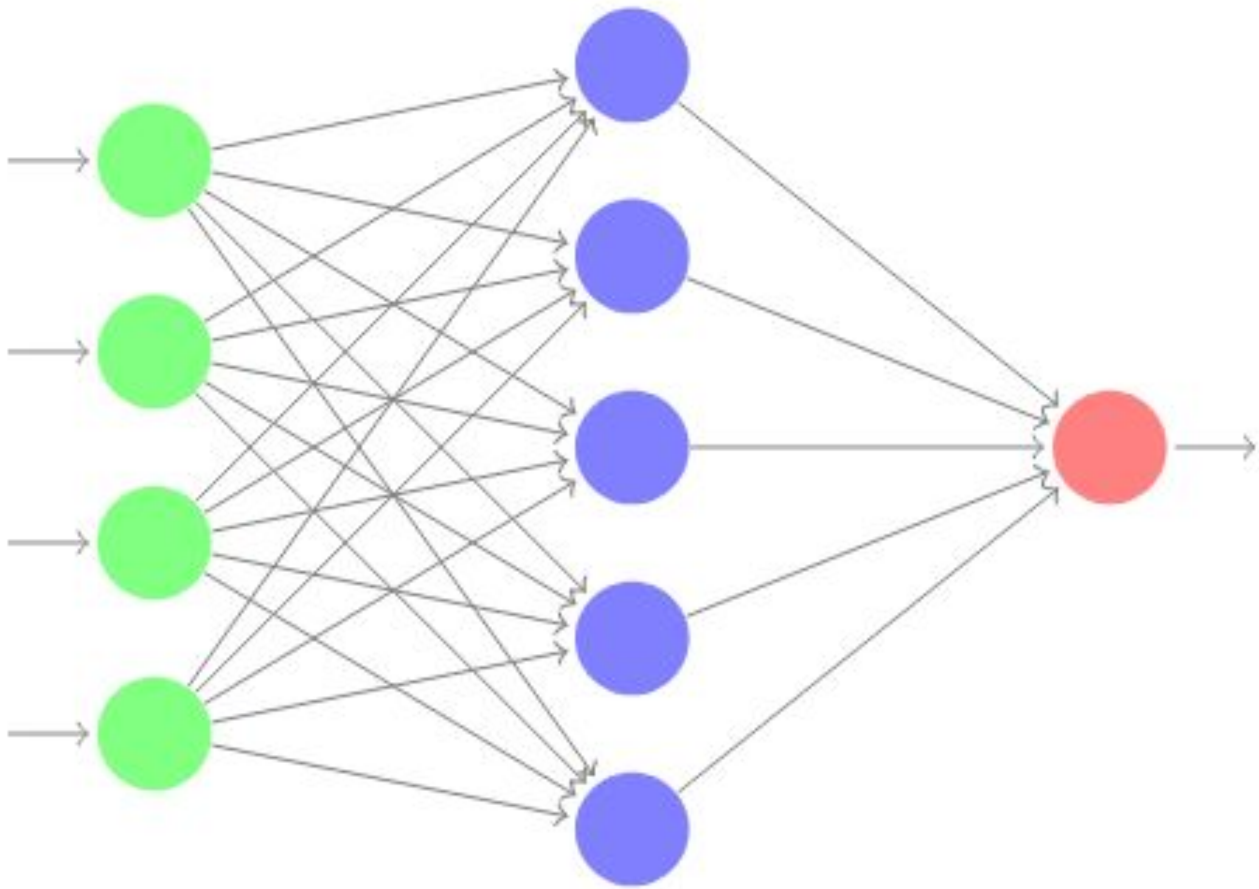
Example: *Guess the correlation* -
Predict correlation from scatter plot



Scatter plot - ***input***

Cor(X,Y) = 0.9
Pred. corr. - ***output***

Neural networks



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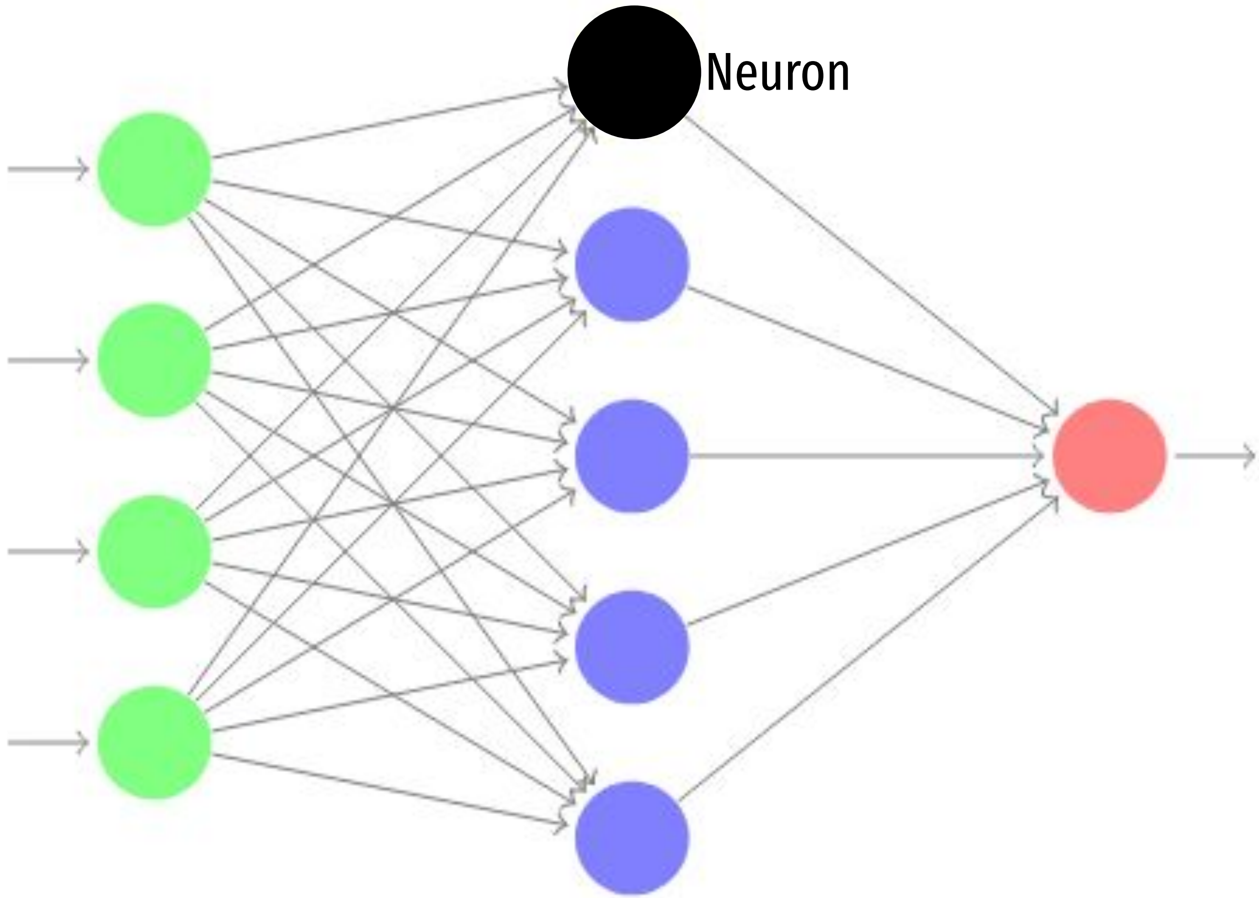

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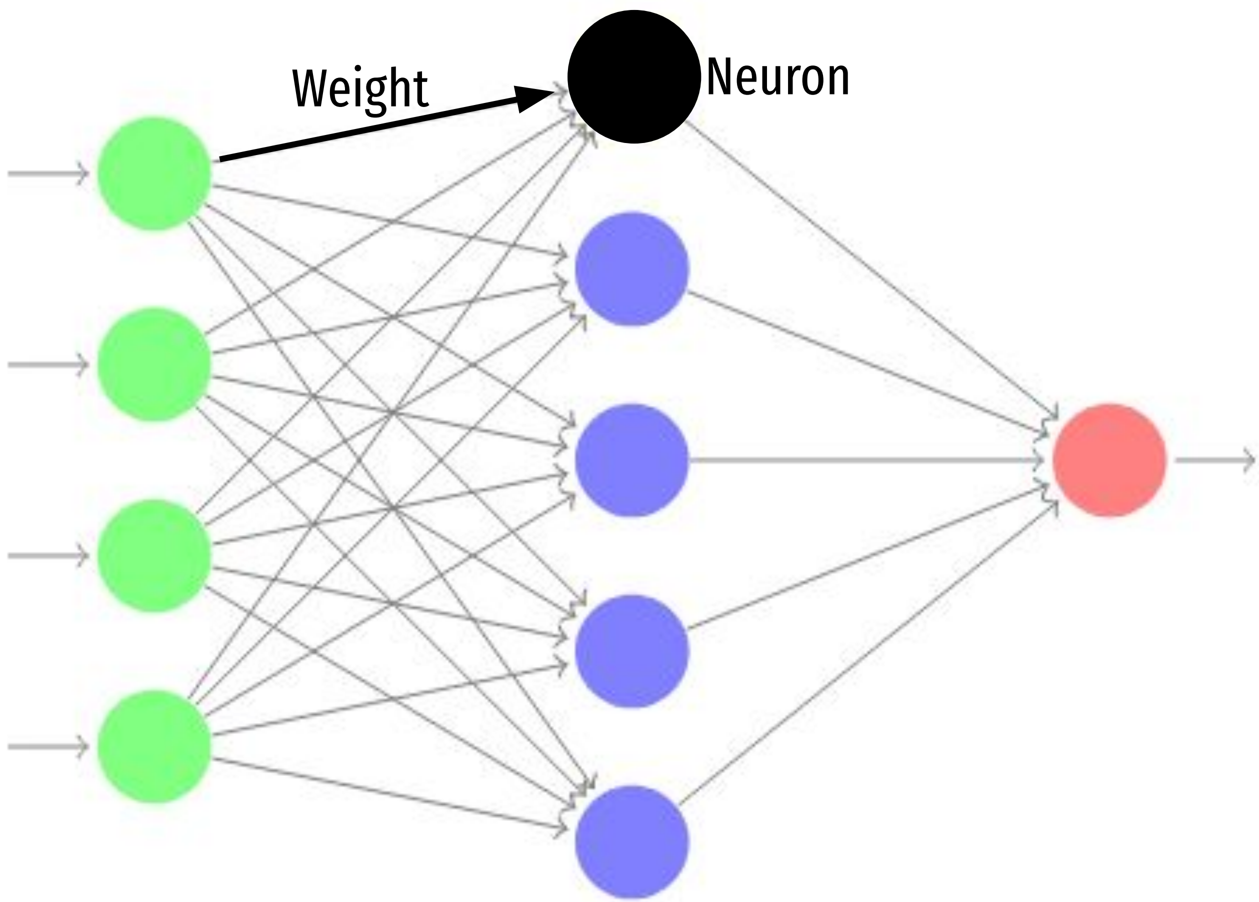

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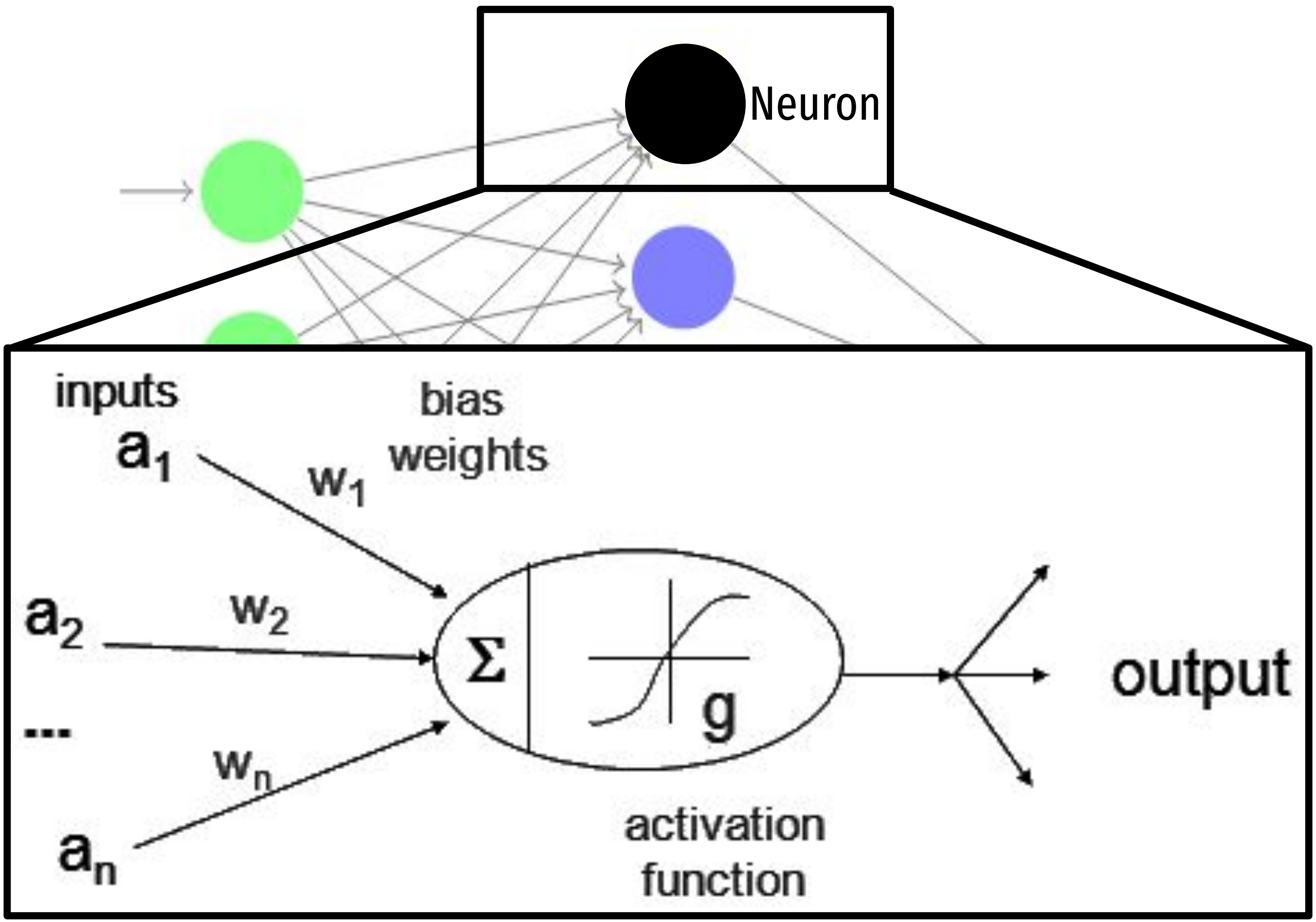

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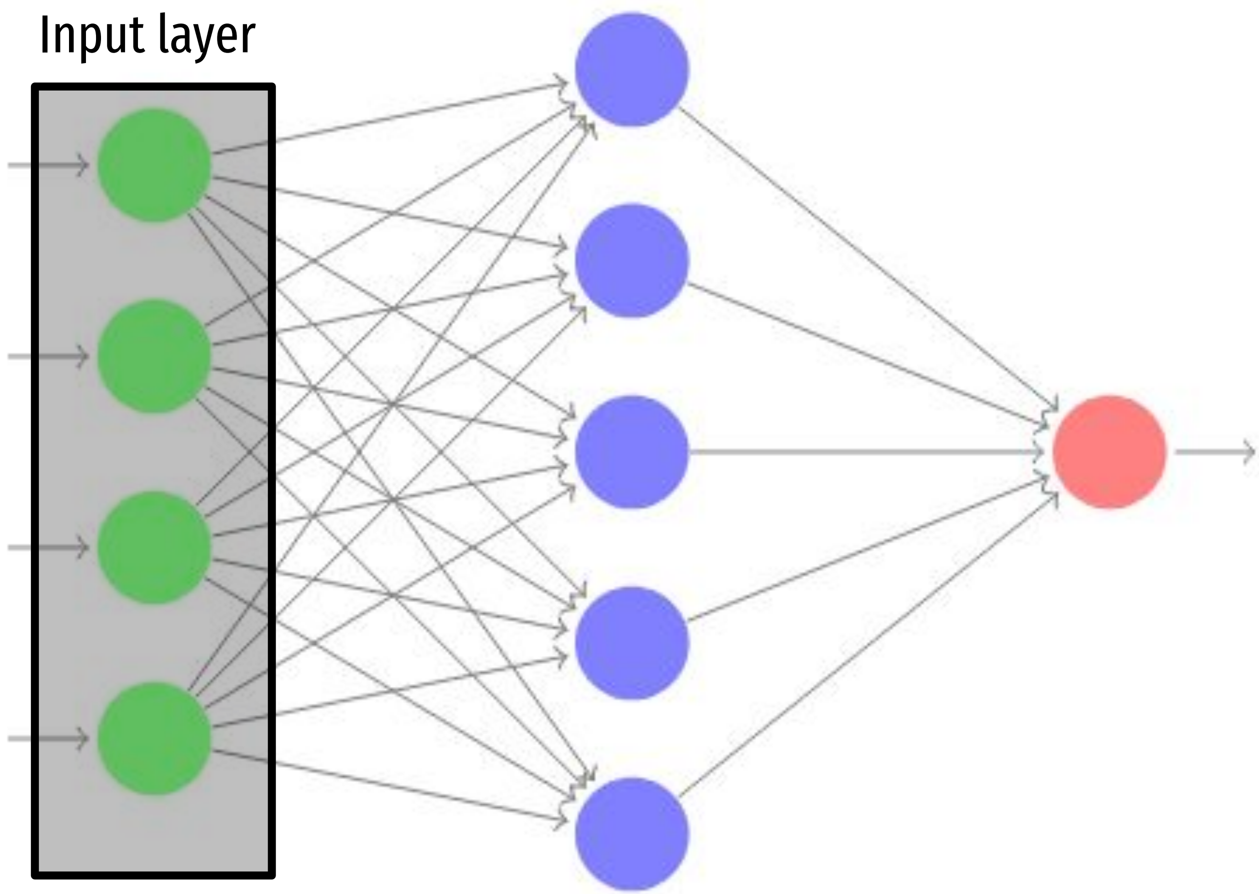

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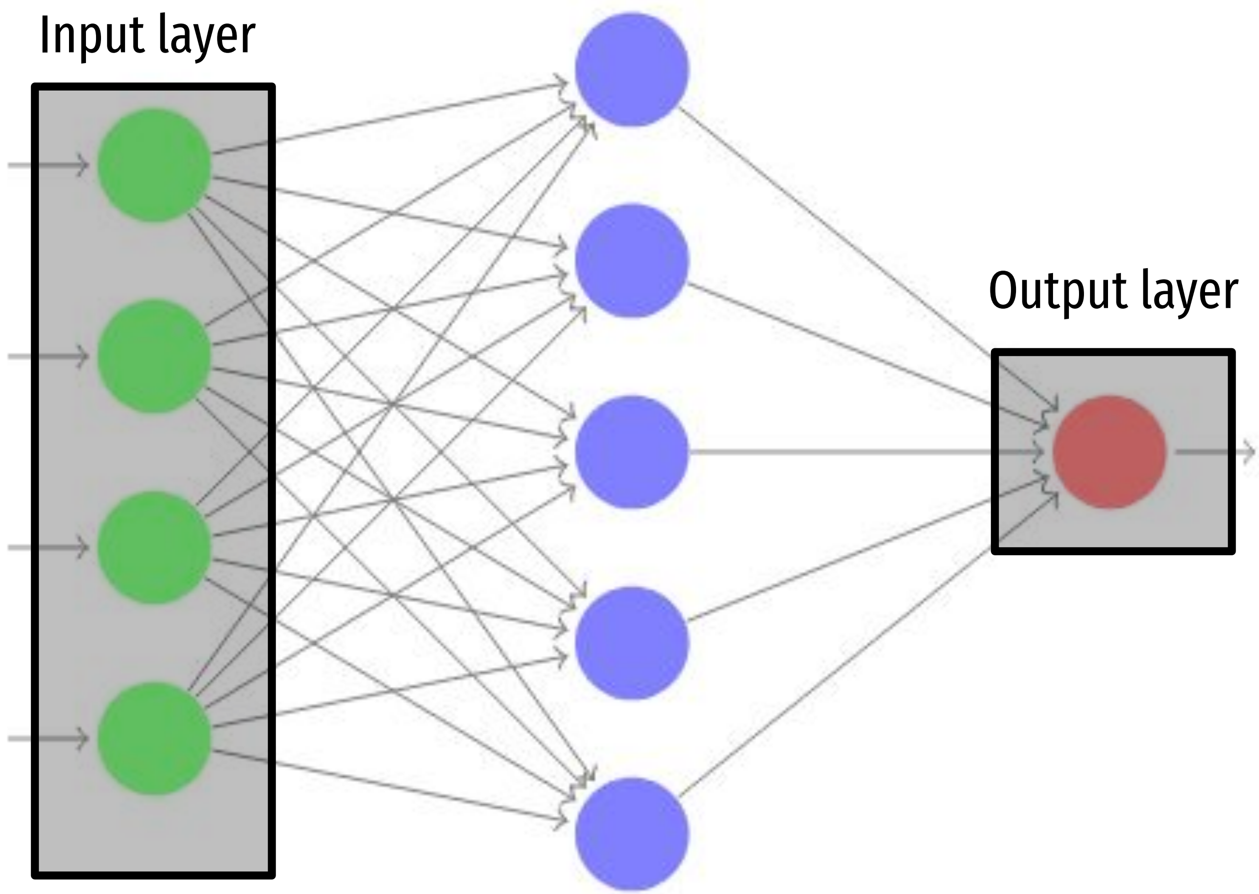

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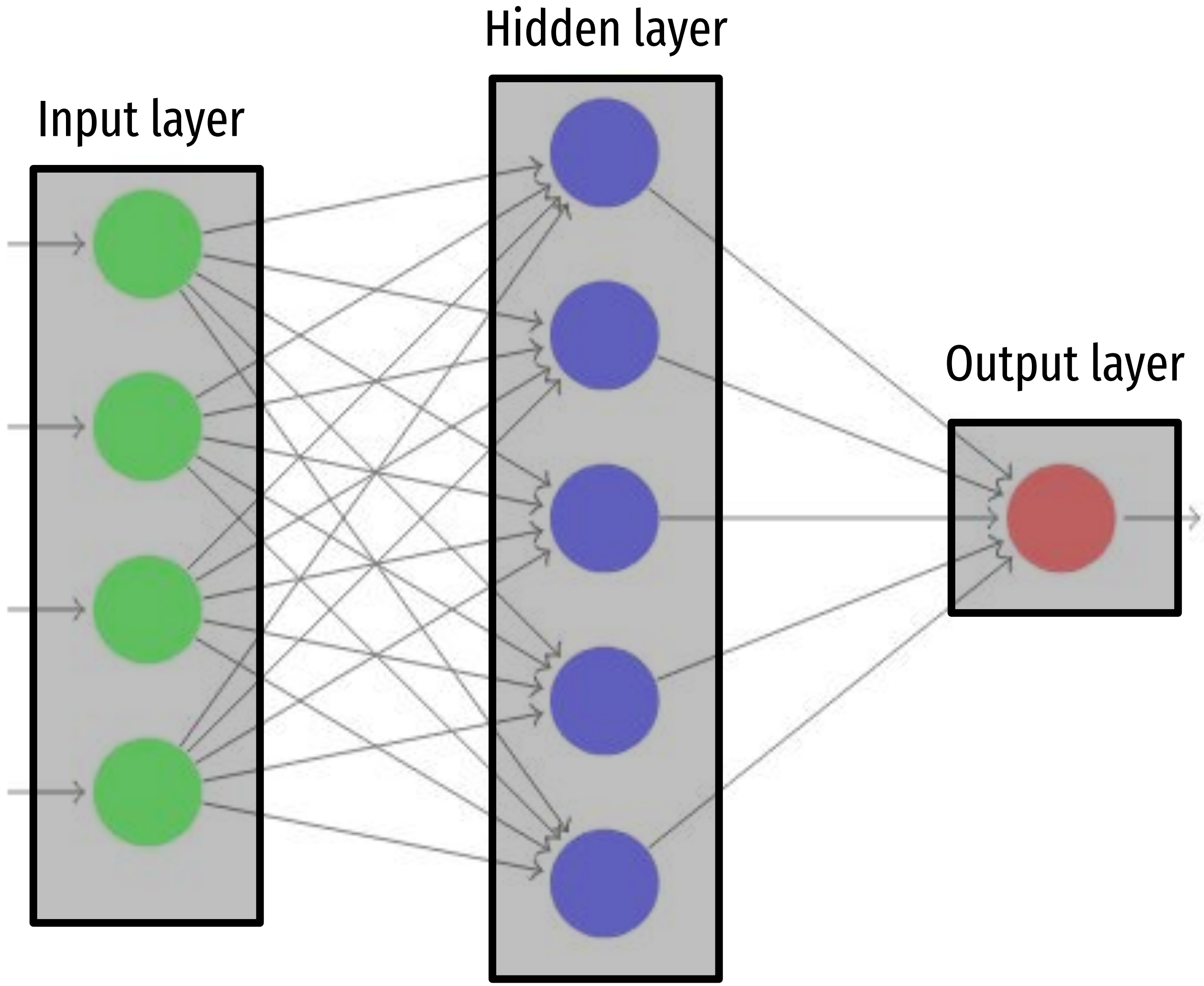
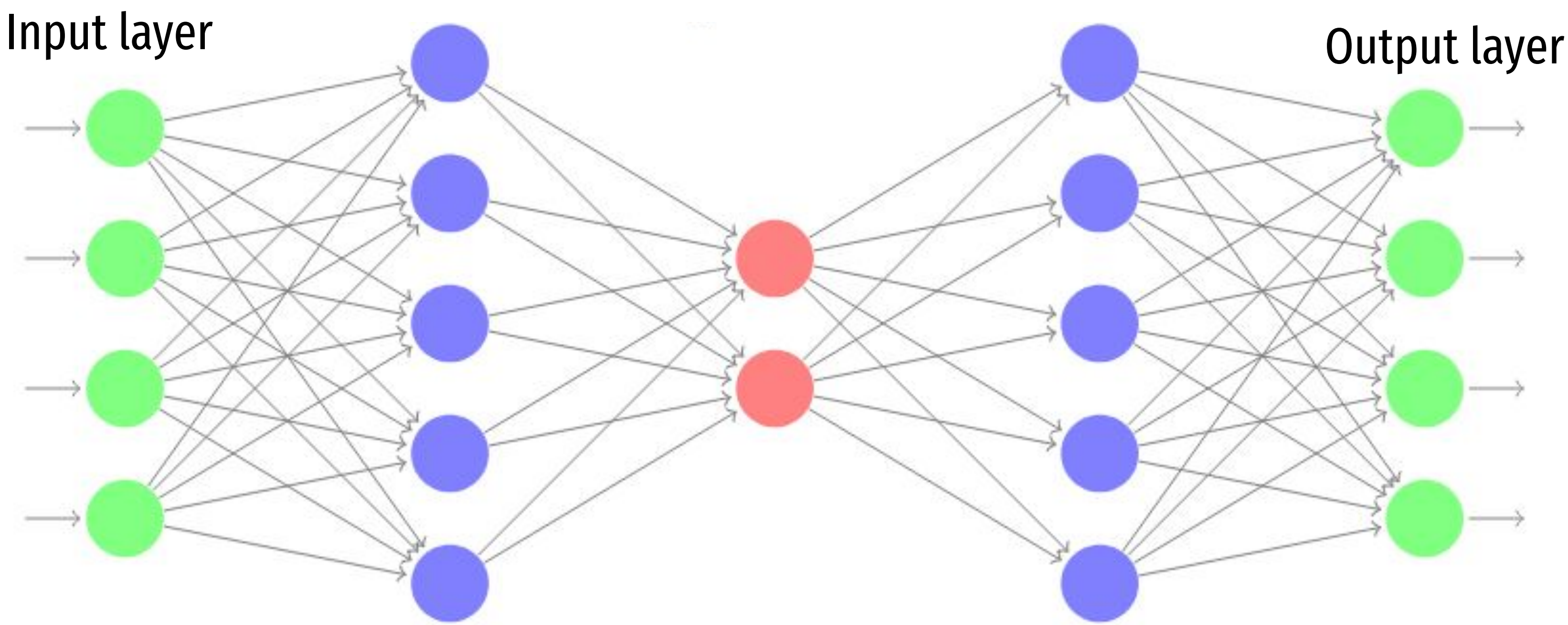


Deep neural network



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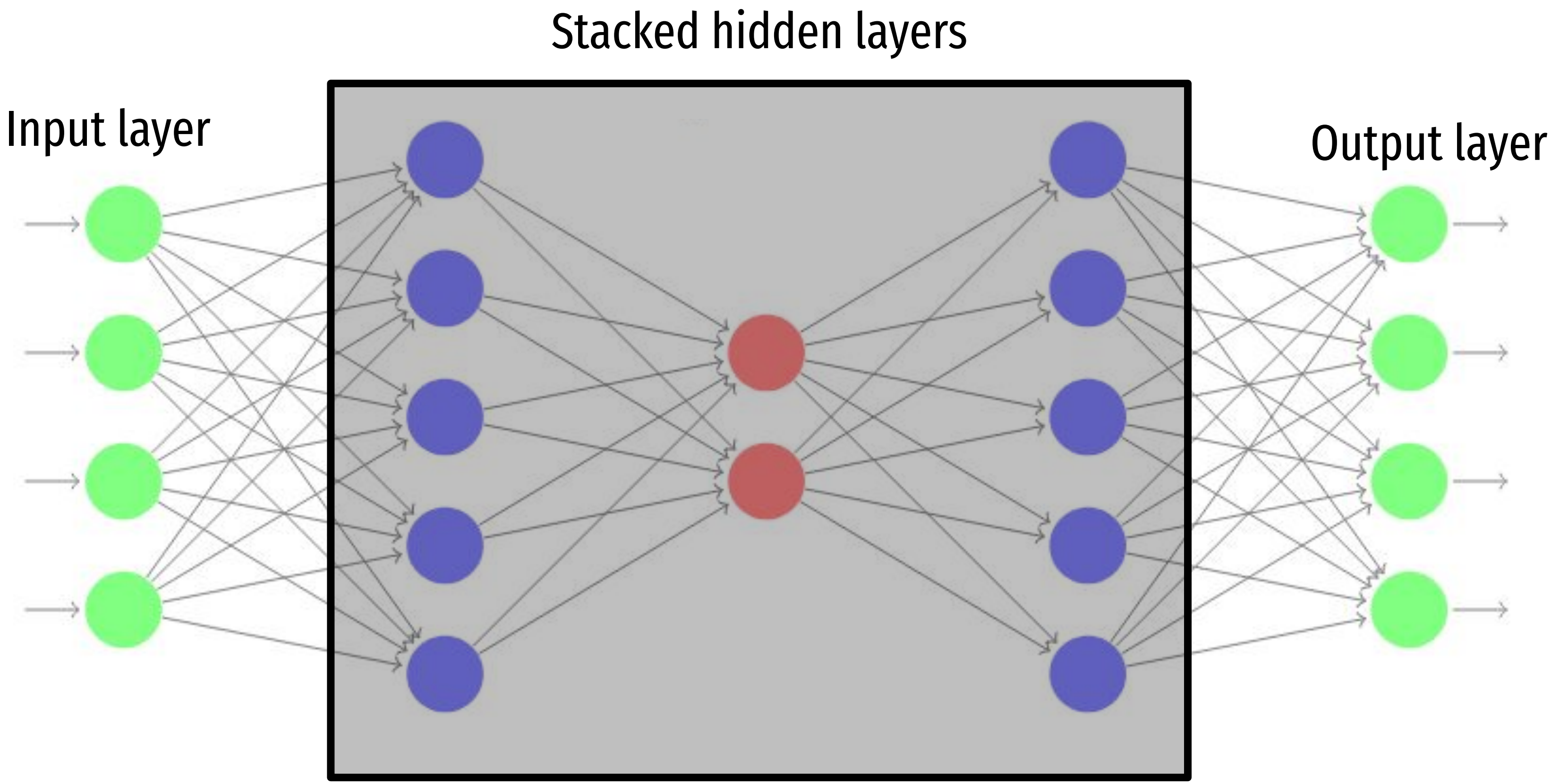

How does the neural network learn?

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Example: *Mean Square Error (MSE)*

$$MSE = \Sigma_i (y_{i,pred} - y_{i,true})^2$$

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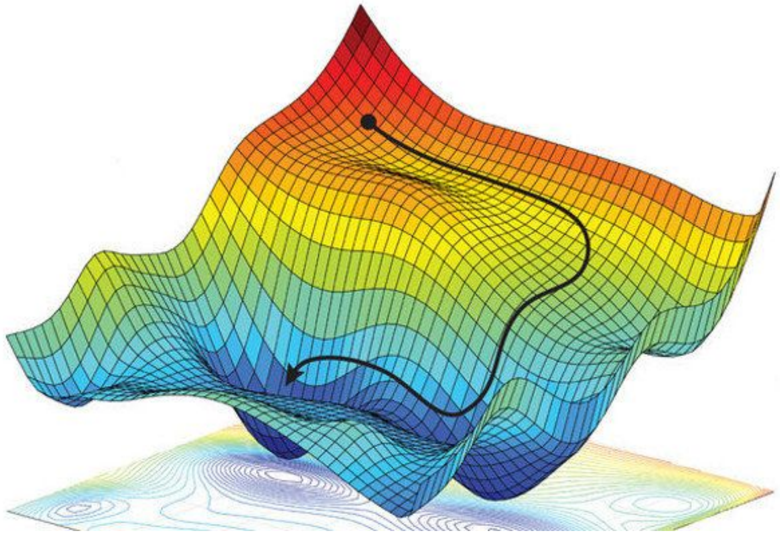
   Compute loss **gradient** vs. weights with **backward propagation**



How do we know that the neural network has learned correctly?

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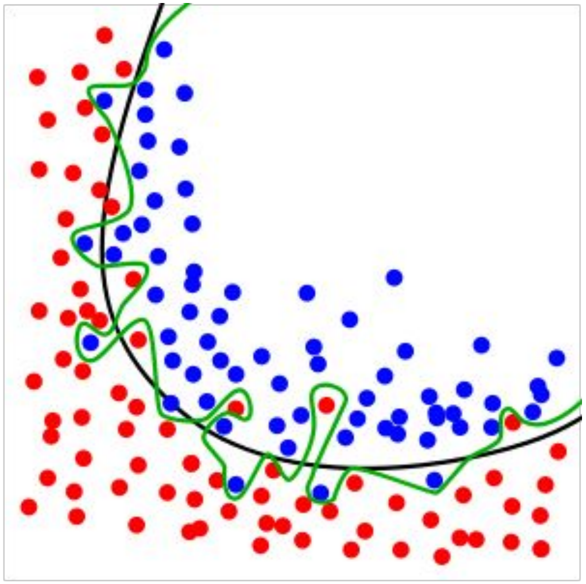
Avoid **overfitting** i.e. neural network learn train data 'by heart' and is not able to extrapolate to new data



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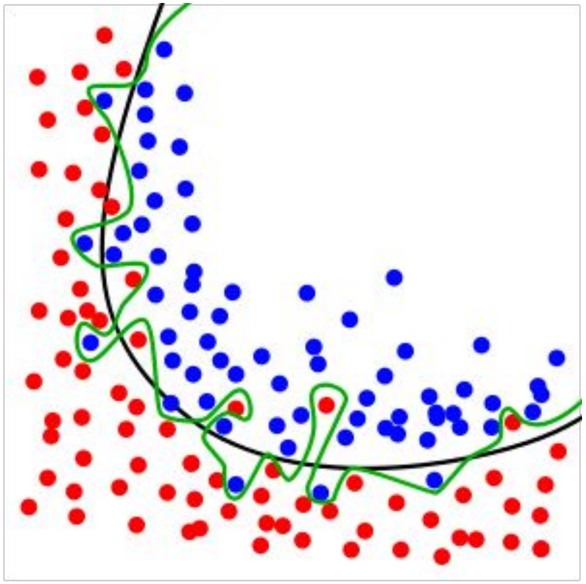
1. Split data set in two subsets: training set & validation set



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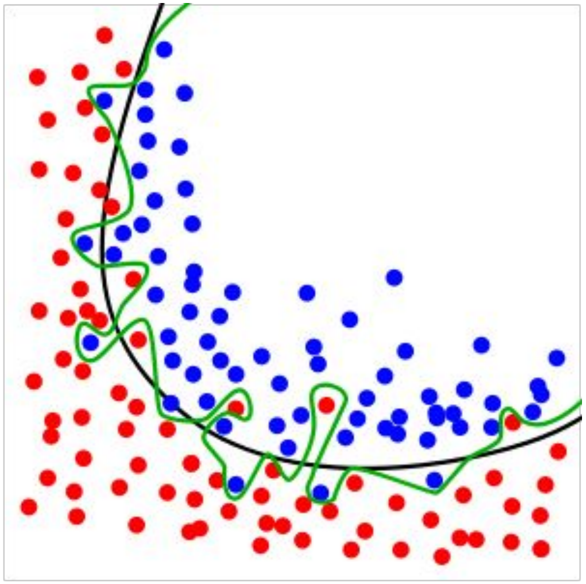

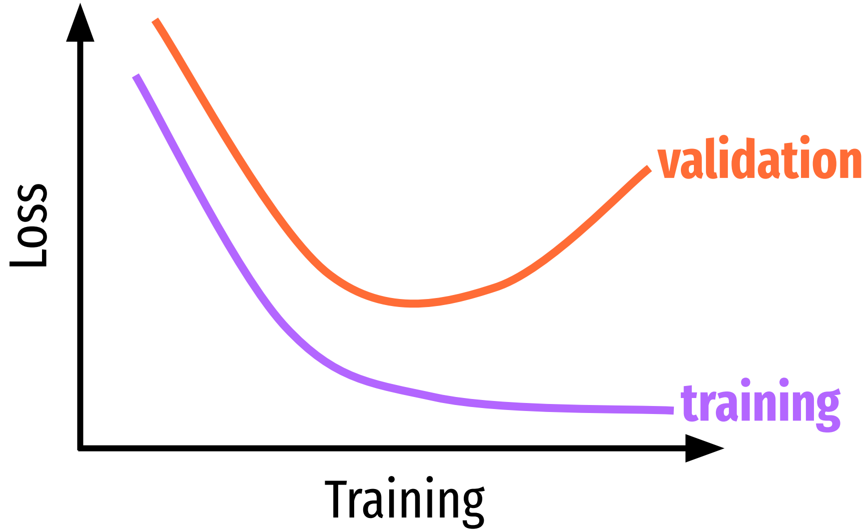

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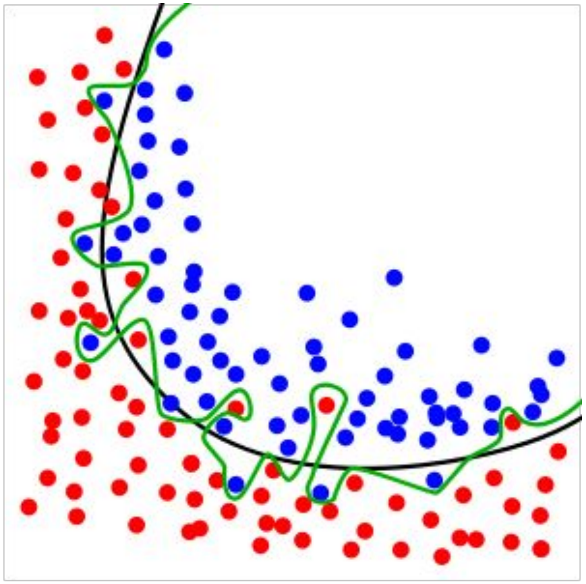
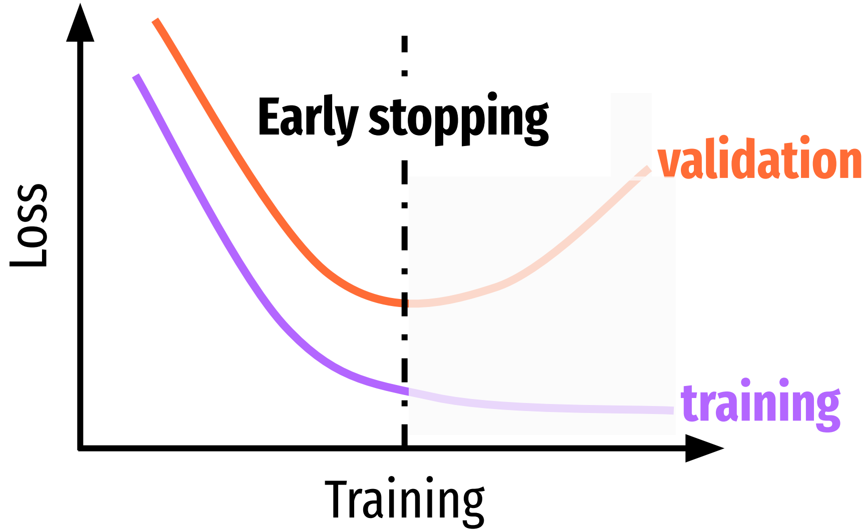
3. Stop the training when validation loss stop to decrease = **early stopping**





Frameworks (in R)

TensorFlow

Torch

TensorFlow

Torch

Google

Facebook

TensorFlow

Google

Industry-focused

Torch

Facebook

Research-focused

TensorFlow

Google

Industry-focused

Easier to learn (Keras)

Torch

Facebook

Research-focused

Harder to learn

TensorFlow	Torch
Google	Facebook
Industry-focused	Research-focused
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TensorFlow	Torch
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Industry-focused	Research-focused
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TensorFlow	**Torch**
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Good documentation	Poor documentation

Examples of use

APPLICATION

Methods in Ecology and Evolution BRITISH ECOLOGICAL SOCIETY

Machine learning to classify animal species in camera trap images: Applications in ecology

Michael A. Tabak[1,2] | Mohammad S. Norouzzadeh[3] | David W. Wolfson[1] | Steven J. Sweeney[1] | Kurt C. Vercauteren[4] | Nathan P. Snow[4] | Joseph M. Halseth[4] | Paul A. Di Salvo[1] | Jesse S. Lewis[5] | Michael D. White[6] | Ben Teton[6] | James C. Beasley[7] | Peter E. Schlichting[7] | Raoul K. Boughton[8] | Bethany Wight[8] | Eric S. Newkirk[9] | Jacob S. Ivan[9] | Eric A. Odell[9] | Ryan K. Brook[10] | Paul M. Lukacs[11] | Anna K. Moeller[11] | Elizabeth G. Mandeville[2,12] | Jeff Clune[3] | Ryan S. Miller[1]

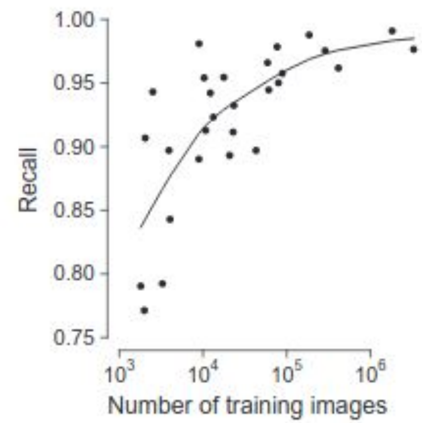
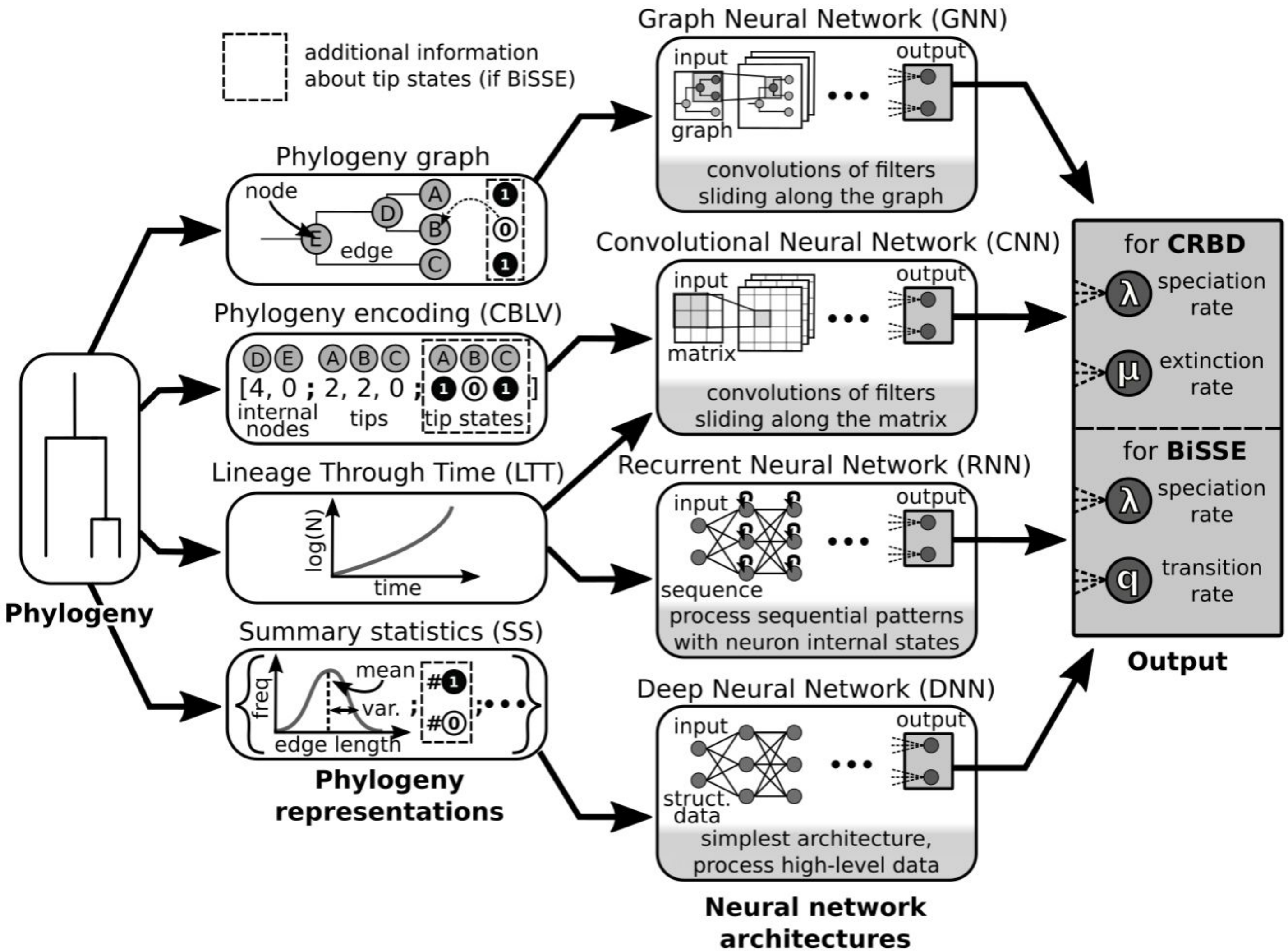


FIGURE 3 Model recall (the ability of the model to recognize species) increased with the size of the training dataset for that species. Points represent each species or group of species. The line represents the result of generalized additive models relating the two variables (see Appendix S9 for details)

Inferring speciation and extinction rates from phylogenies



Thanks!

Questions