

Deep Learning

Lecture Topic: What is Deep Learning

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Learning Objectives:

- 1. Understand what deep learning is.**
- 2. Understand what a neuron is.**
- 3. Understand how to train a neural network.**

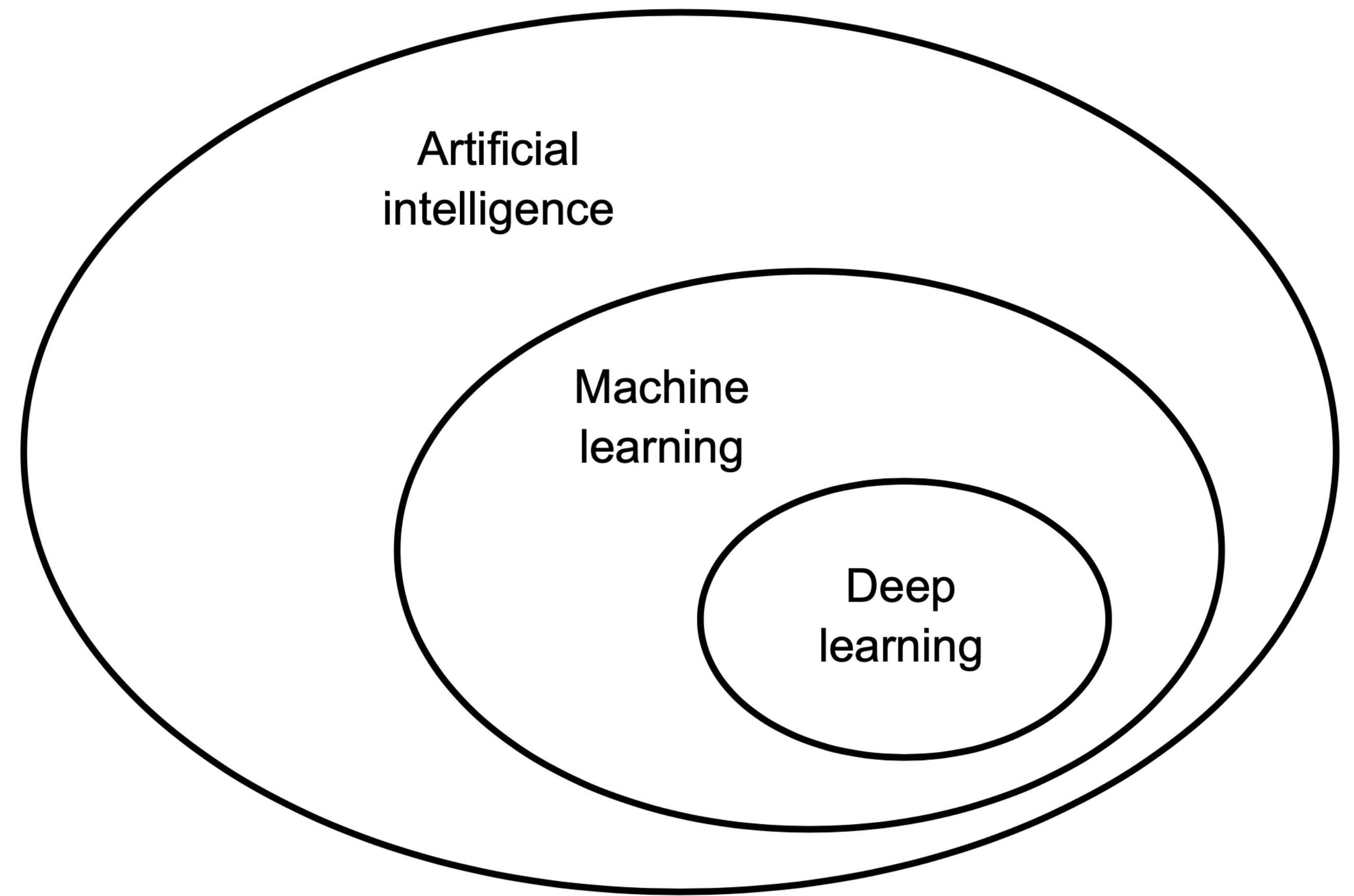
Roadmap of this lecture:

1. What is machine learning and deep learning.

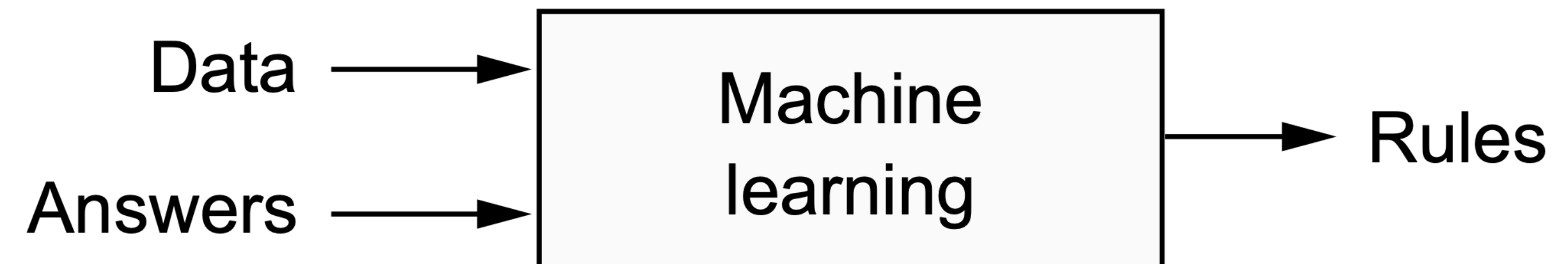
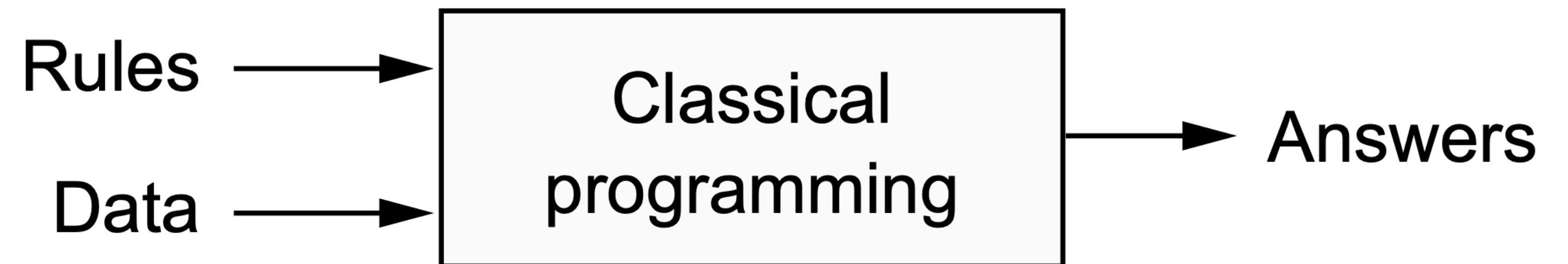
2. What is feature extraction.

3. What is a neuron and a neural network.

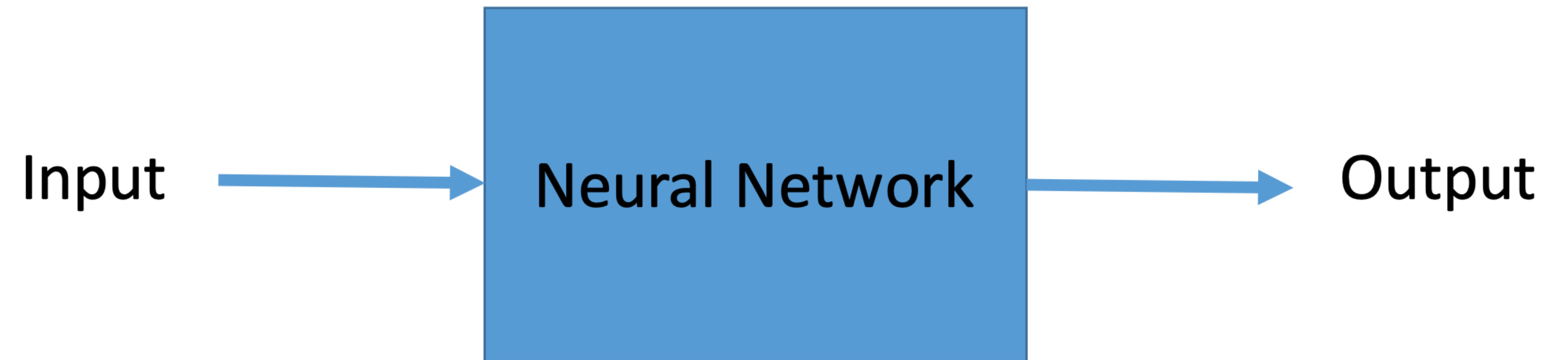
4. How to train a neural network.



Difference between classical algorithms and machine learning



Deep Learning and Neural Network



What neural network is doing: computing (often transformation of features/representations, and making a final decision).

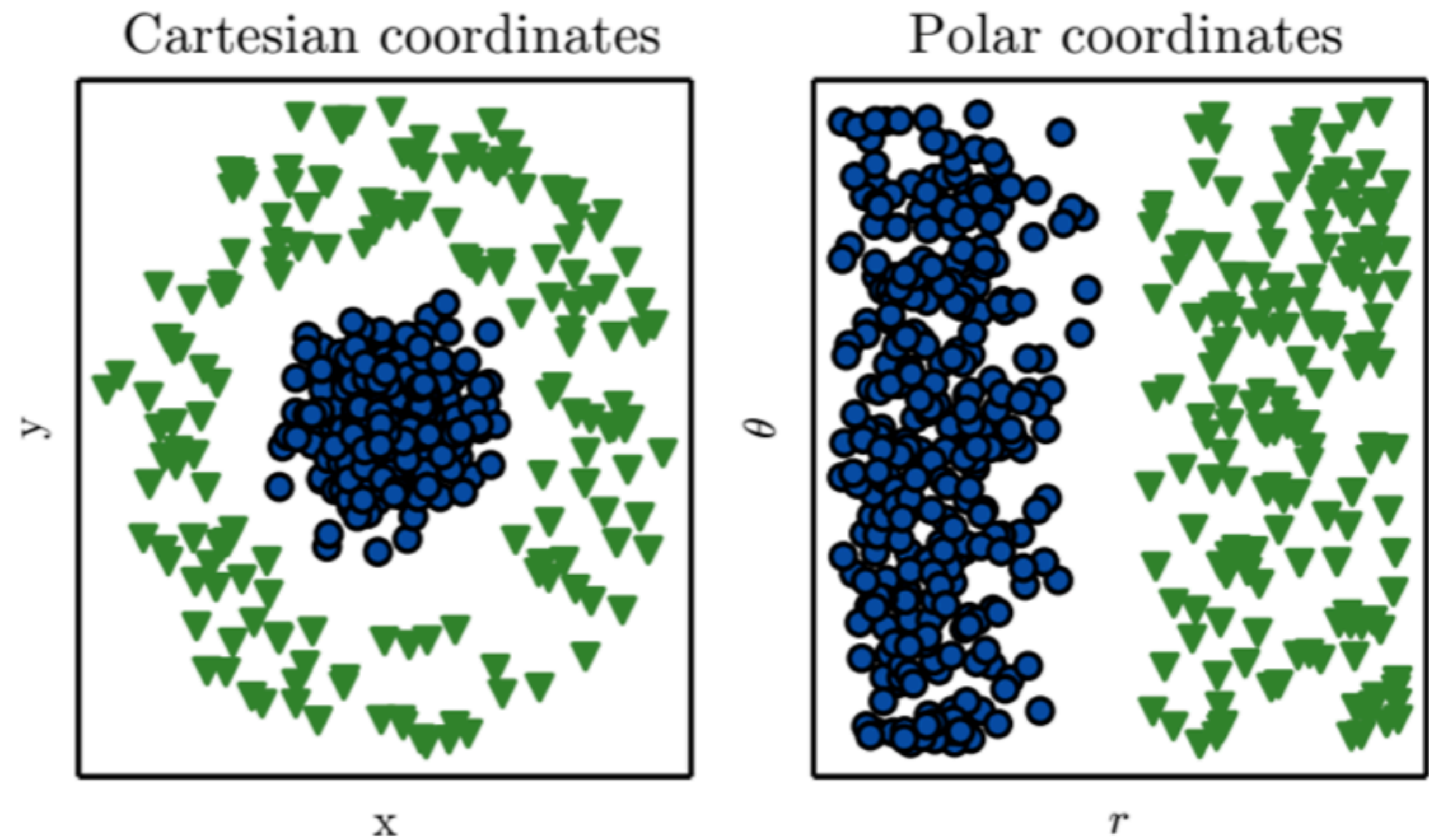
Quiz questions:

1. What is the difference between machine learning and algorithm design?
2. What is the relation between machine learning and deep learning?

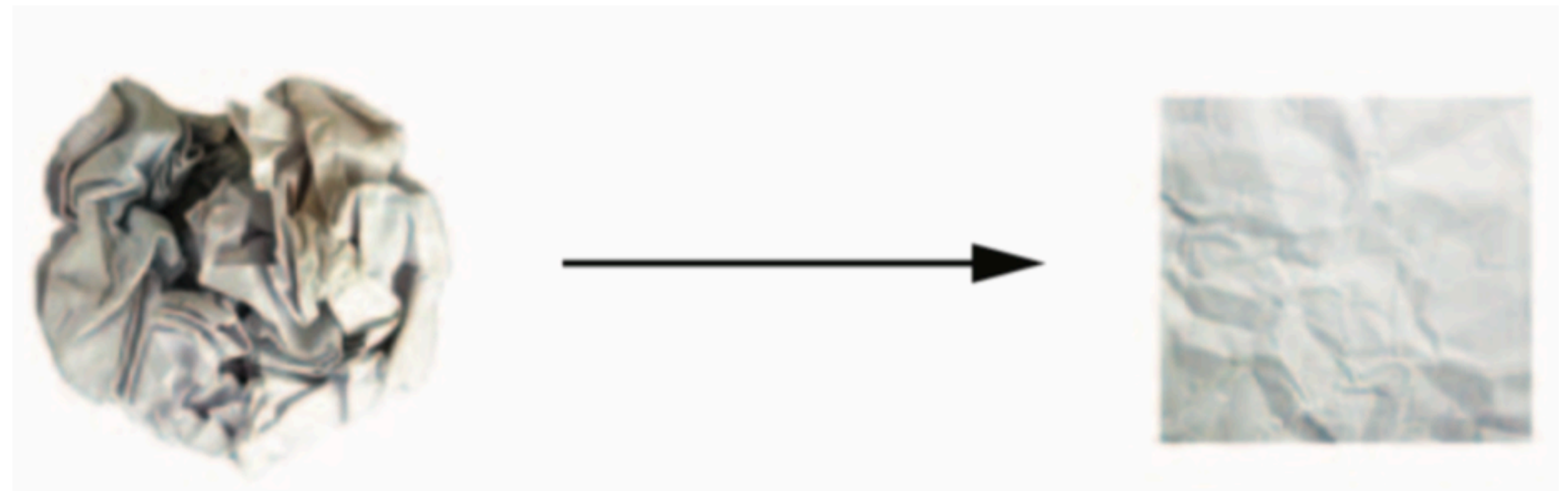
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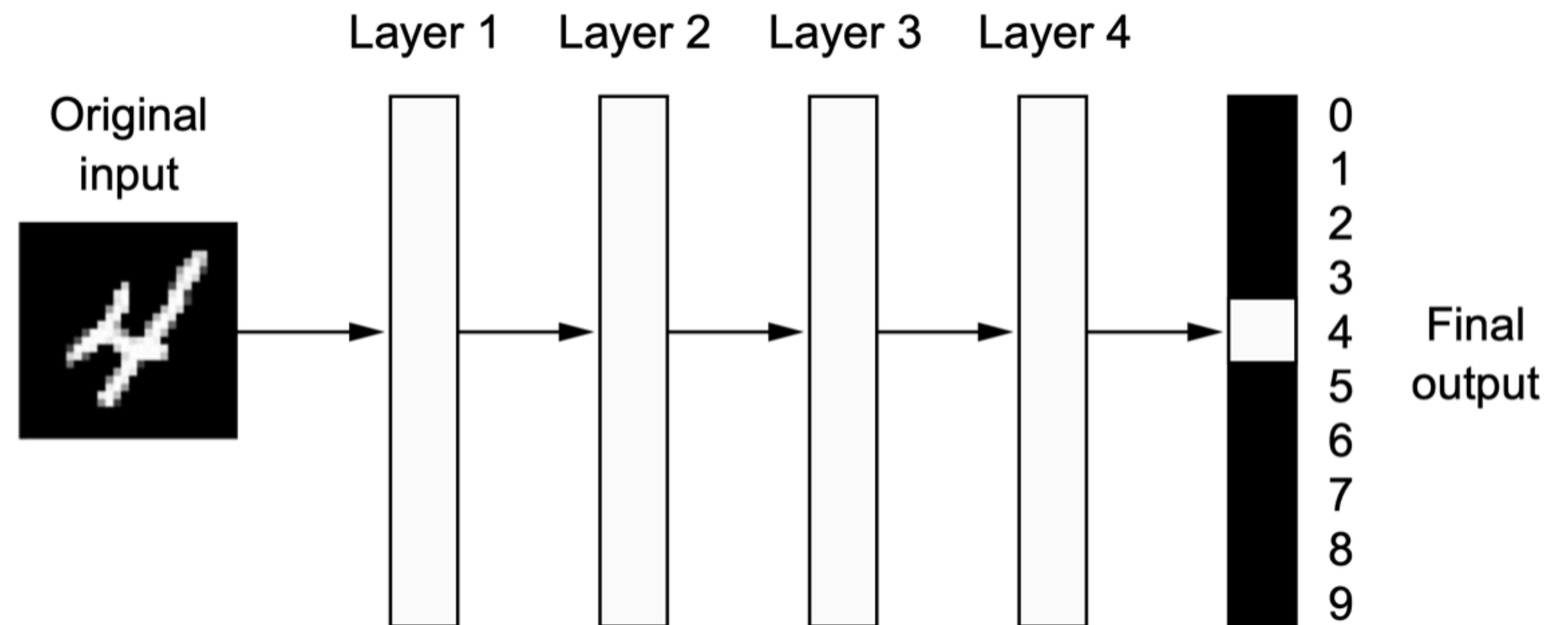
Example of Transformation



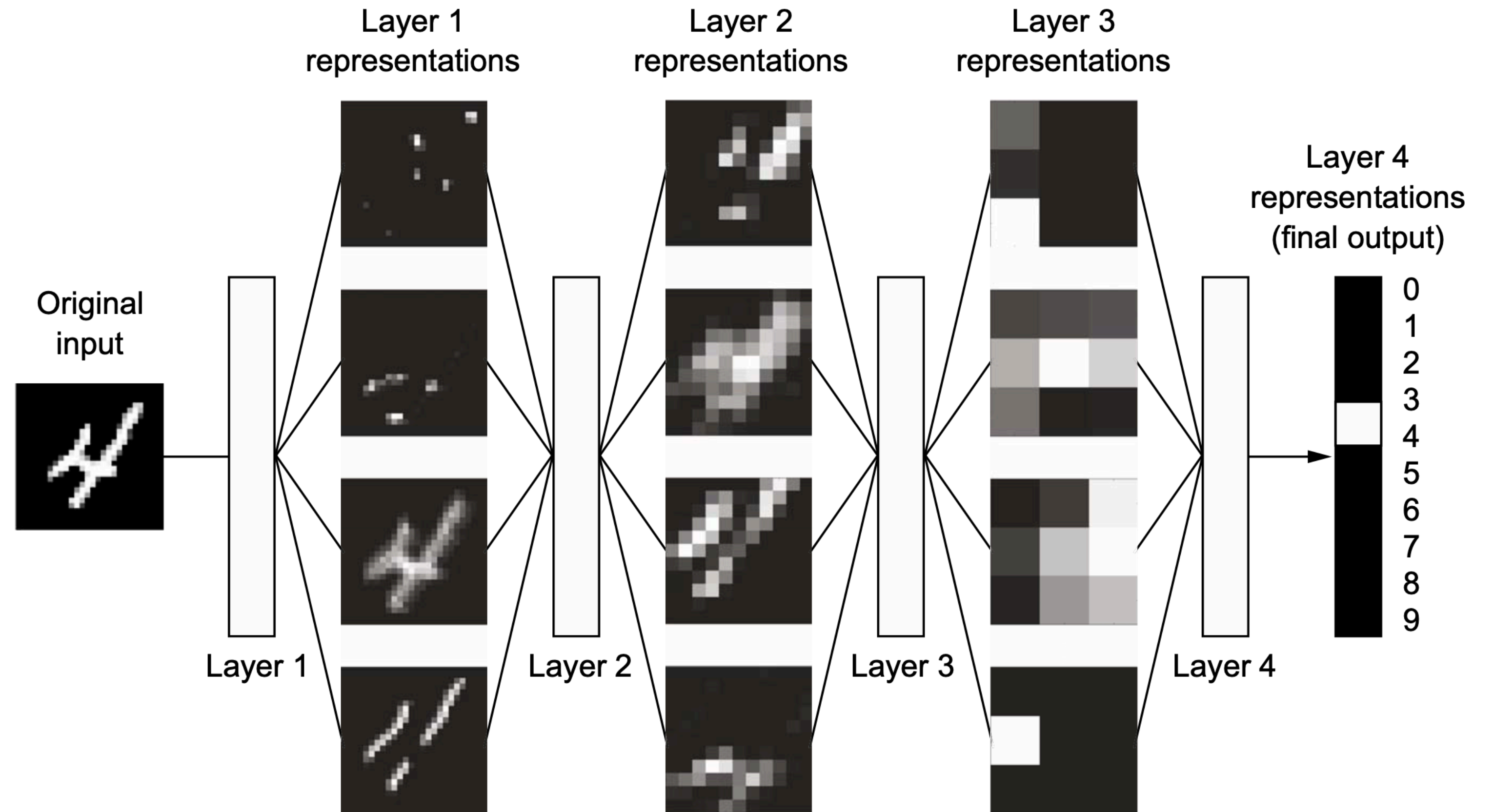
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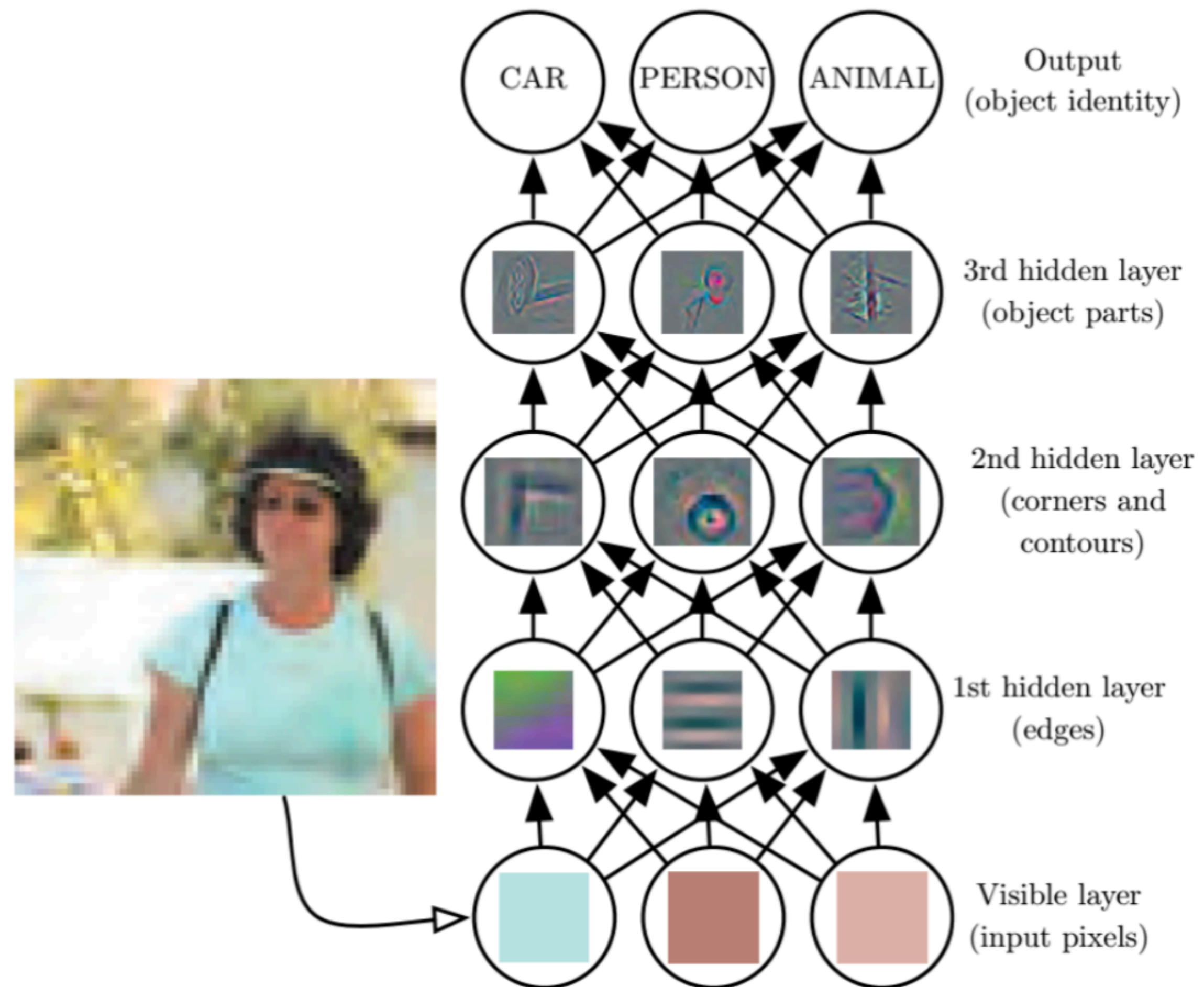
Example: handwritten digit recognition



What features are detected in different layers of a neural network



What features are detected in different layers of a neural network



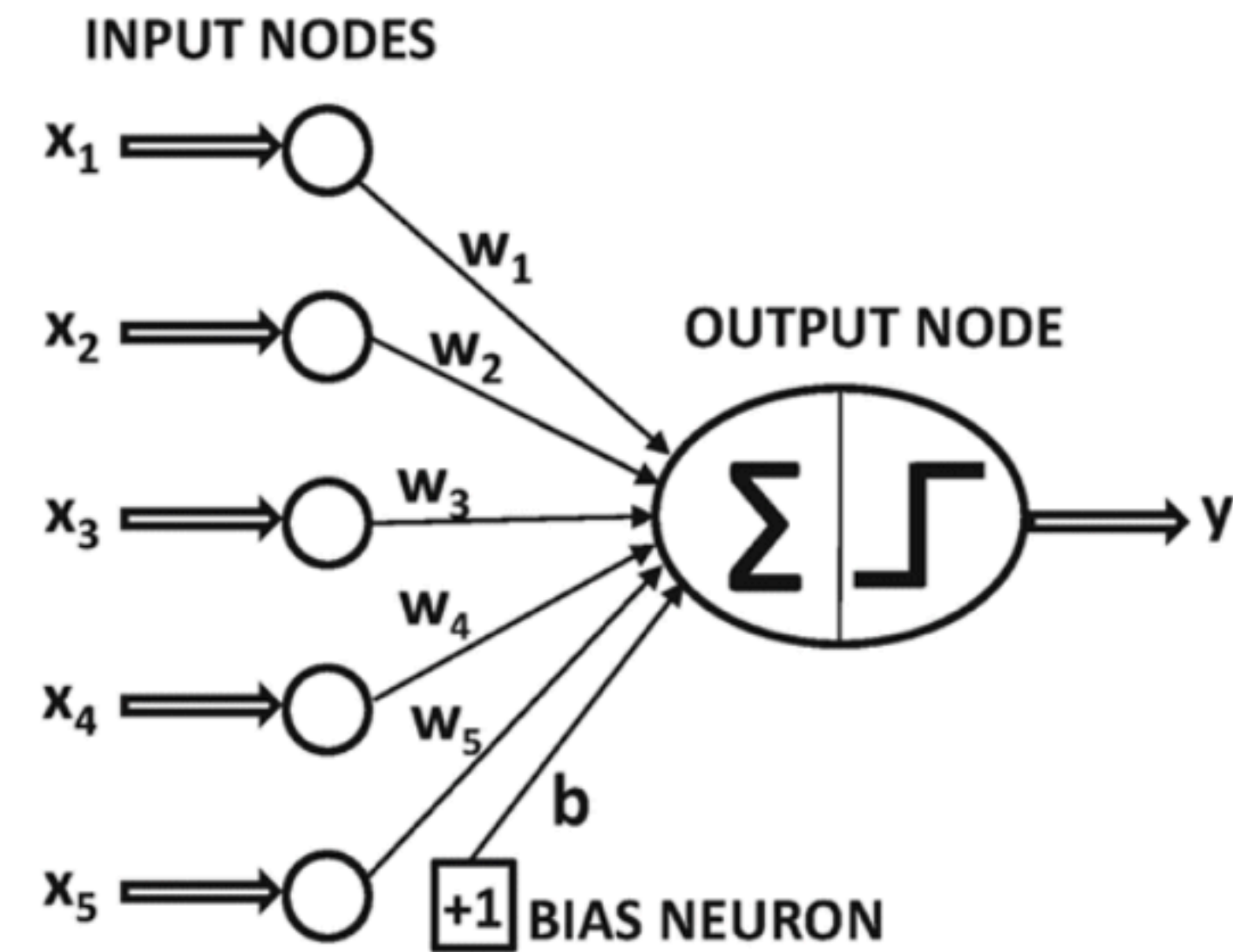
Quiz question:

1. What is the importance of feature extraction?

Roadmap of this lecture:

1. What is machine learning and deep learning.
2. What is feature extraction.
3. What is a neuron and a neural network.
4. How to train a neural network.

What is a neuron



Perceptron with bias

$$\hat{y} = \text{sign}\{\bar{W} \cdot \bar{X} + b\} = \text{sign}\left\{\sum_{j=1}^d w_j x_j + b\right\}$$

What is a neural network

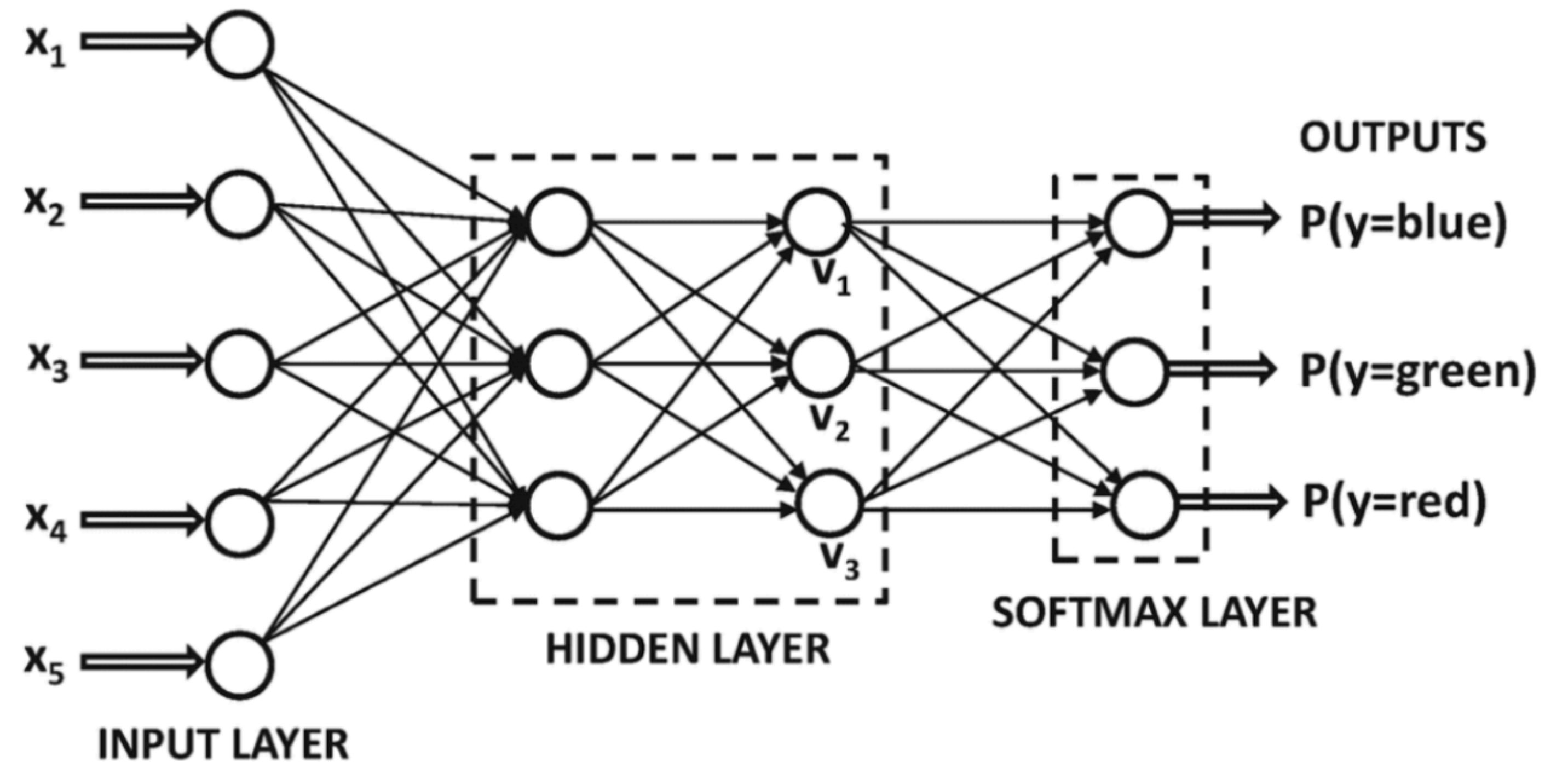


Figure An example of multiple outputs for categorical classification with the use of a softmax layer

Quiz questions:

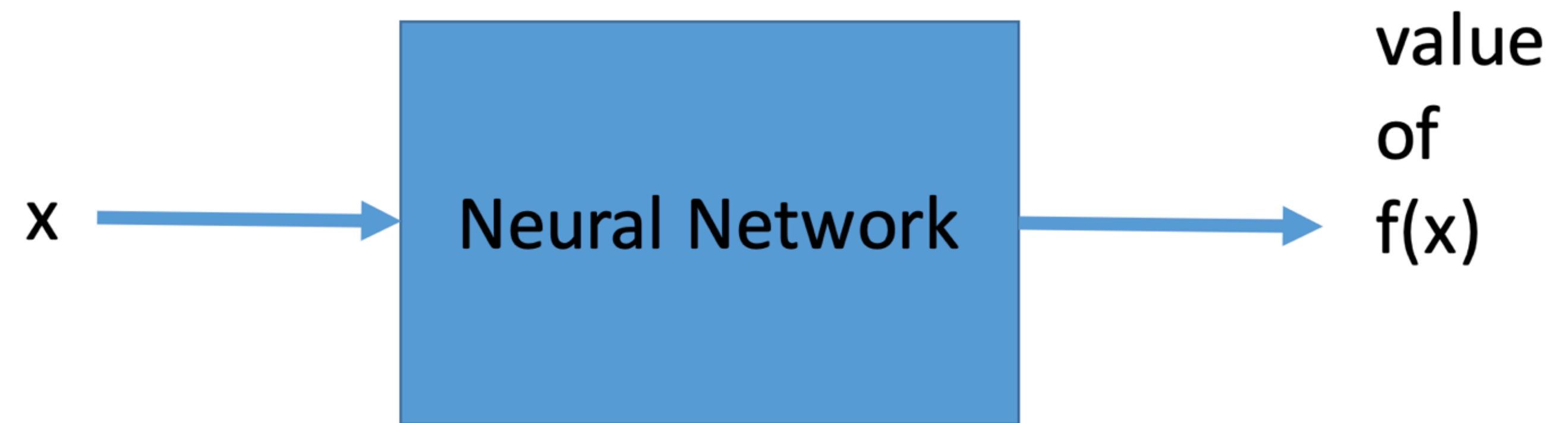
1. What is a neuron?

2. What is a neural network?

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4. How to train a neural network.

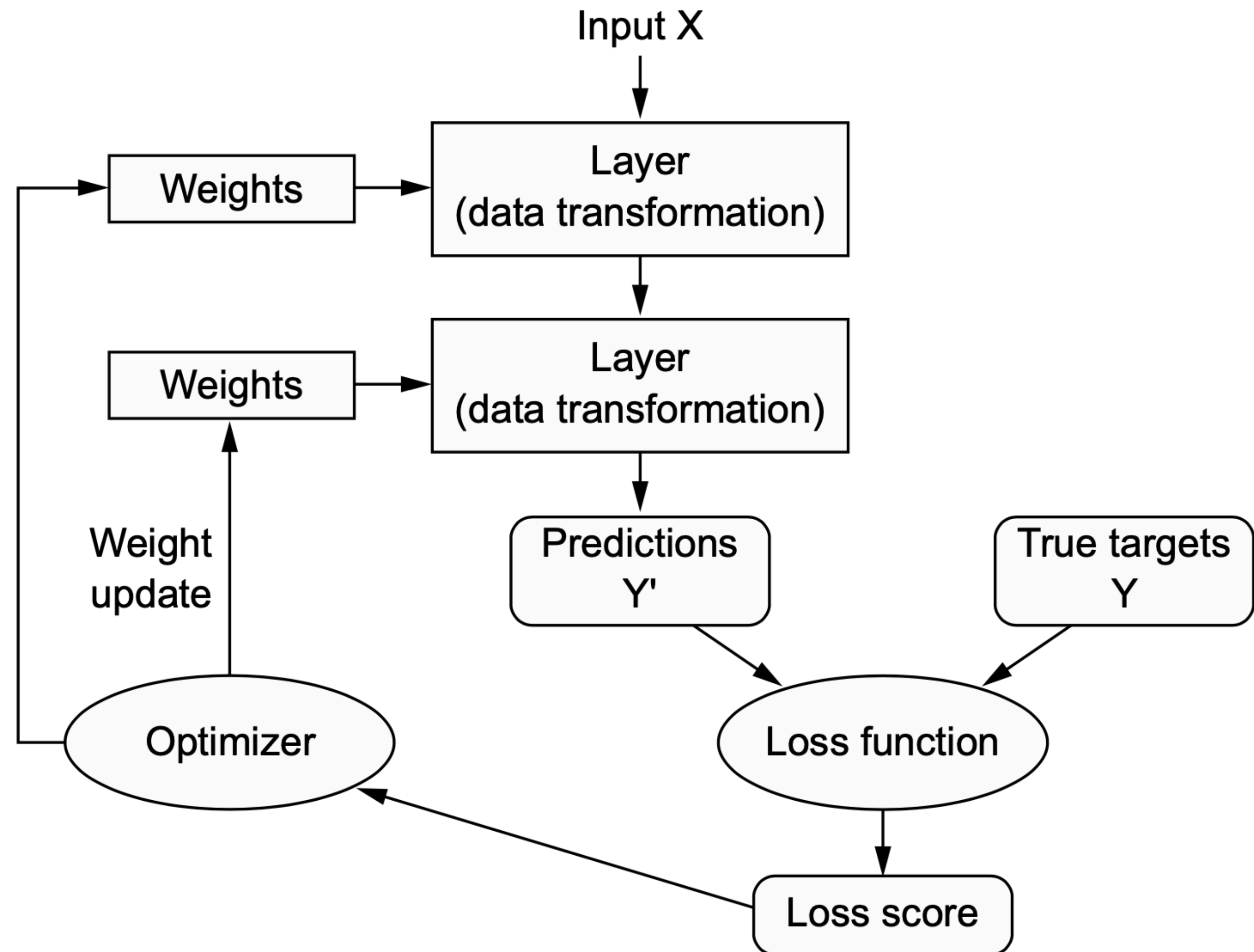
How to train a neural network



The neural network learns the function $f(x)$, either exactly or approximately.

1. Use a lot of (input, output) pairs to train the neural network.
2. Adjust weights to minimize the difference between $f(x)$ and the neural network's predicted values of $f(x)$

How to train a neural network



Applications of Deep Learning

- Computer vision (smart camera, robot, self-driving cars, etc.)
- Natural language processing (machine translation, chatbot, etc.)
- Game playing (alpha Go, video games, etc.)
- Create art or products (painting, music, poem, fashion, etc.)
- Data storage and transmission (data compression, transmission, etc.)
- Finance and economy (trading, recommendation, economy survey, etc.)
- Healthcare (read X-ray pictures, diagnosis, drug design, etc.)
- Physics, business, education, smart homes, etc. (More and more applications every day.)

Quiz questions:

1. What is the process of training a neural network?
2. Why do we need lots of data for training a neural network?