Supervised learning

It is a learning to map input data to known targets (also called annotations)

Applications of deep learning such as, optical character, recognition, speech recognition, image classification, and language translation falls in SL category.

Although supervised learning mostly consists of classification and regression, there are more exotic variants as well, including the following (with examples):

- **Sequence generation**

Given a picture, predict a caption describing it. Sequence generation can sometimes be reformulated as a series of classification problems (such as repeatedly predicting a word or token in a sequence).

- **Syntax tree prediction**

Given a sentence, predict its decomposition into a syntax tree.

- **Object detection**

Given a picture, draw a bounding box around certain objects inside the picture. This can also be expressed as a classification problem (given many candidate bounding boxes, classify the contents of each one) or as a joint classification and regression problem, where the bounding-box coordinates are predicted via vector regression.

- **Image segmentation**

Given a picture, draw a pixel-level mask on a specific object.

Unsupervised learning

Finds interesting transformations of the input data without the help of any targets, for the purposes of *data visualization, data compression, or data denoising*, or to *better understand the correlations present in the data* at hand.

Unsupervised learning is often a necessary step in better understanding a dataset before attempting to solve a supervised-learning problem.

Dimensionality reduction and clustering are well-known categories of unsupervised learning.

Self-supervised learning

Self-supervised learning is a type of supervised learning that doesn't require human-labeled data. Instead, the labels are generated from the input data using a heuristic algorithm.

Examples of self-supervised learning include autoencoders, predicting the next frame in a video, or the next word in a text. The distinction between supervised, self-supervised, and unsupervised learning is not always clear-cut. Self-supervised learning can be interpreted as either supervised or unsupervised learning, depending on the context.

Reinforcement learning

In reinforcement learning, an agent receives information about its environment and learns to choose actions that will maximize some reward.

For instance, a neural network that "looks" at a video-game screen and outputs game actions in order to maximize its score can be trained via reinforcement learning.

It gained attention when Google DeepMind successfully applied it to learning to play Atari games and Go. However, it is still mostly a research area with limited practical applications beyond games. In the future, we expect to see it being used in self-driving cars, robotics, resource management, education, and more.

Classification and regression glossary

Sample or input: One data point that goes into your model.

Prediction or output: What comes out of your model.

Target: The truth. What your model should ideally have predicted, according to an external source of data.

Prediction error or loss value: A measure of the distance between your model's prediction and the target.

Classes: A set of possible labels to choose from in a classification problem. For example, when classifying cat and dog pictures, "dog" and "cat" are the two classes.

Label: A specific instance of a class annotation in a classification problem. For instance, if picture #1234 is annotated as containing the class "dog," then "dog" is a label of picture #1234.

Ground-truth or annotations: All targets for a dataset, typically collected by humans.

Binary classification: A classification task where each input sample should be categorized into two exclusive categories.

Multiclass classification: A classification task where each input sample should be categorized into more than two categories: for instance, classifying handwritten digits.

Multilabel classification: A classification task where each input sample can be assigned multiple labels. For instance, a given image may contain both a cat and a dog and should be annotated both with the "cat" label and the "dog" label. The number of labels per image is usually variable.

Scalar regression: A task where the target is a continuous scalar value. Predicting house prices is a good example: the different target prices form a continuous space.

Vector regression: A task where the target is a set of continuous values: for example, a continuous vector. If you're doing regression against multiple values (such as the coordinates of a bounding box in an image), then you're doing vector regression.

Mini-batch or batch: A small set of samples (typically between 8 and 128) that are processed simultaneously by the model. The number of samples is often a power of 2, to facilitate memory allocation on GPU. When training, a mini-batch is used to compute a single gradient-descent update applied to the weights of the model.