Machine learning has become vital to the modern world, turning data into real, actionable insights. In radiotherapy, there has been a continuous increase in patient-specific needs met with the help of artificial intelligence, from quality personalized treatment to medical imaging.

In the machine learning field, there are two main types of tasks: supervised, and unsupervised. Supervised learning enables organizations to use data to understand and prevent unwanted outcomes or boost desired outcomes for their target variable. Unsupervised learning is equally important, drawing inferences from datasets without labels. This article will:

- Define and explain supervised learning
- Discuss the inner-workings of supervised learning, including classification and regression
- Provide a brief overview of and unsupervised learning
- Give real-world examples of the role machine learning plays in cancer patient care

What is Supervised Learning?

Supervised learning is a subcategory of machine learning defined by its use of a ground truth (the actual nature of the problem which is the target of a machine learning model, reflected by the relevant data sets associated with the use case). A machine learning model is a tool or algorithm that has been trained to make decisions based on certain data sets. During supervised learning, these training data sets contain prior knowledge of what the output values of the samples should be.

During training, the model will have both data and its labels available and will attempt to learn a function from the data to the label. The features and output of labels are used to learn a mapping from one to the other using machine learning algorithms. After it has been trained, the model can take in new data and predict a label using its learned function. To evaluate the model, the labels it predicts on a test set of unseen samples are compared to the ground truth labels from the test set.

MVision AI uses supervised learning to train its auto-segmentation models. By using the latest supervised deep learning-based techniques, patterns in the medical images can be learned using the available labels. With data carefully curated and labeled in-house, MVision AI ensures that the anatomic models are provided with the highest quality, and comply with official consensus guidelines.

This image displays a schematic representation of training and test data.

The Inner Workings of Supervised Learning

Supervised methods learn by looking at the data and its target output. The model tries to predict the target for a given input and is given feedback (supervised) about its performance so that it can adjust its parameters to improve the prediction in the future.

This image shows a real-world example of regression and classification in the analysis of lung tumors.

Classification

Classification utilizes an algorithm to accurately assign test data into specific categories. In medical imaging, classification is paramount. One of the many examples is classification's effective detection and segmentation of classes, such as tumors. Traditional methods rely mainly on the shape, color, and/or texture features and their combinations. Recent deep learning methods provide an effective way to construct an end-to-end model that can compute final classification labels with the raw pixels of medical images. Lai, and HuiFeng) Classification is used in image segmentation for quality auto-contouring results. An example of classification when determining the size of the lung tumor can be seen in the lung tumor example above. During classification, a relevant question to ask would be, "Is the patient's lung tumor small or large?".