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FORMS OF REPRESENTATION OF 3D DATA FOR MACHINE LEARNING

In recent years, machine learning has been developing at an accelerated pace, and 3D modeling of objects using machine vision elements and neural networks is an interesting and problematic area of scientific research.

One of the main components of machine learning is the data on which the training of a neural network model depends. The more inputs, the more accurate the learning ability will be. For the same data, their representations may differ, which will affect the choice of a machine learning model.

The representation of 3D data for machine learning depends on the goals and objectives that need to be solved. At the moment, there is no standard for the form of data representation that would be both compact, computationally efficient, and easily extracted from real data. There are several forms of 3D data representation, each with its own advantages and disadvantages.

1. Voxels.

A voxel is the 3D analogue of a pixel (Figure 1a). Voxels represent a three-dimensional object and contain information about its properties at a certain spatial level. In a computer, voxels are stored as a three-dimensional matrix. This form of 3D data representation is used in various fields such as computer graphics, medical imaging, and robotics.

2. Clouds of points.

A point cloud (Figure 1b) is a set of three-dimensional coordinates measured at various points on an object's surface. Points can be used to create 3D models whose surfaces are displayed as multiple points. Point clouds are widely used in various fields, including reverse engineering, prototyping, and animation.

3. Cubes.

A cube is a type of volumetric pixel that consists of subsets of voxels that form hierarchy grids. The use of cubes improves the efficiency of processing huge 3D data.

4. Multiplanar raster images.

This method is based on splitting a 3D object into many layers, similar to slices of CT and MRI scanners. With this approach, each layer is represented in the form of a two-dimensional image, which makes the data processing more efficient.

5. Segmented / mesh models.

Segmented models (Figure 1c) are used to identify and classify objects in 3D scenes. This form of 3D data representation is based on the division of a volumetric object into smaller components.

6. Functions models / CAD.

The main idea of a solid model is the use of a functional description (Figure 1d) of surfaces and a functional description of the physical properties of objects. Solid/functional models are used in a variety of industries, including engineering, manufacturing, medicine, and architecture.

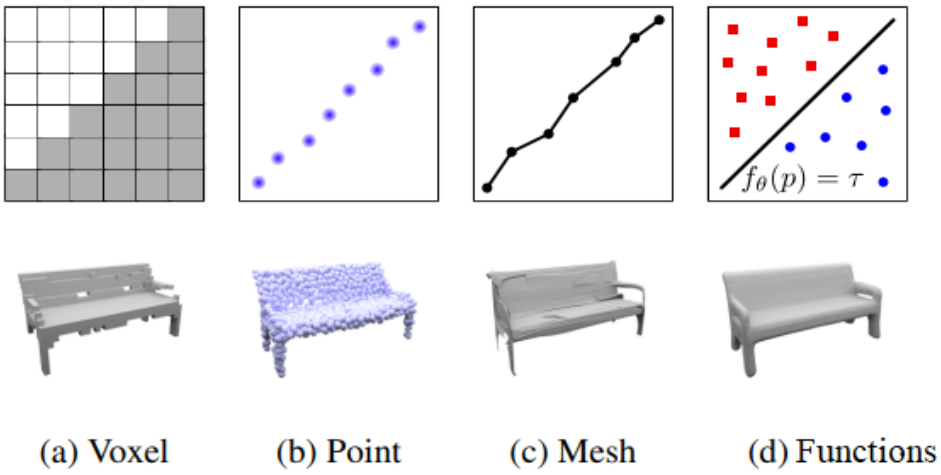

Figure 1 – Types of representation of 3D data

In conclusion, the representation of 3D objects for machine learning is an important component in various fields, such as medicine, games industry, architecture, etc. Correct representation of 3D data helps to improve the quality and accuracy of object analysis, and also increases the efficiency of computer algorithms.

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