Types of Learning

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1. **Introduction**

Learning from data sets is the process of discovering patterns and trends in it.

This process (characterization) is called learning or induction from data.

In general there are four types of learning. These are:

- Unsupervised learning
- Supervised learning,
- Reinforcement learning,
- Semi-supervised learning

The relatively recent and very successful, deep learning techniques are also defined.

2. **Unsupervised Learning**

In unsupervised learning, there are no output measures.

However, based upon input measures, the goal is to generate patterns from the input data, and describe associations among them.

Some examples are clustering of data, generation of association rules, and sequential pattern mining.

1. Let $\mathcal{X}$ be the set of data points. Each data point in the set $\mathcal{X}$ is characterized by a set of attributes.

   The goal of the clustering algorithm is to determine groups of data points in the set $\mathcal{X}$ with 'similar' characteristics.

   The grouping of data points depends upon the concept of *similarity* or *distance* between the points.

2. Another example of unsupervised learning scheme involves discovery of useful and interesting associations (relationships or dependencies) in large sets of data items.

   The different items occur in transactions which can be either extracted from a database, or are generated by some external process.

3. Sequential pattern mining is concerned with discovering interesting sequences in the data set.

3. **Supervised Learning**

The goal of supervised learning is to predict output measures (target vectors) based upon input measures (input vectors).

Examples of supervised learning are:

- Statistical methods like Bayesian methods,
- Support vector machines,
- Nearest-neighbor classification,
- Artificial neural networks,
- Regression analysis,

- Decision trees,
- Rule-based algorithms, and
- Ensemble methods.

4. **Reinforcement and Semi-supervised Learning**

Supervised and unsupervised learning are at the two ends of the learning spectrum.

Reinforcement and semi-supervised learning techniques fall in the middle of these two extremes.

5. **Reinforcement Learning**

Compared to unsupervised learning algorithms, the learning algorithm is offered reinforcement.

However, when compared to supervised learning, the supervision is offered in lesser detail.

That is, supervision is offered only in aggregation of information.

6. **Semi-supervised Learning**

The semi-supervised algorithms are also called learning with knowledge-based hints.

For example, it is possible for clustering algorithms to execute under partial supervision.

7. **Deep Learning**

Deep learning is about learning data representations, as opposed to task-specific algorithms. Learning can be supervised, semi-supervised or unsupervised. These algorithms:

- Use a cascade of multiple layers of nonlinear processing units for feature extraction and transformation. Each successive layer uses the output from the previous layer as input.

- Learn multiple levels of representations that correspond to different levels of abstraction; the levels form a hierarchy of concepts.