Introduction to Unsupervised Learning

In unsupervised learning only the input data is known, and we do not provide the algorithm with any output data.
It is important to contrast this with supervised learning, where the input data is paired with corresponding desired outputs provided by a given teacher or supervisor.

In unsupervised learning, the algorithm explores patterns and structures within the data without explicit guidance, often clustering similar items or reducing the dimensionality of the input space.

Although unsupervised learning methods find success in many applications, they are usually harder to understand and evaluate. That is, when we have an unsupervised learning algorithm, it is difficult to measure how good it is. So, evaluating such algorithms is more complex than for supervised learning algorithms.

Let us now see some examples of unsupervised learning tasks.

A first task is identifying topics in a set of blog posts. If we have a large collection of text data, we might want to summarize it and find prevalent themes. We might not know beforehand what these topics are or how many there might be, and therefore there are no known outputs.

Another example is segmenting customers into groups with similar preferences. Given a set of customer records, we might want to identify which customers are similar and whether there are groups with shared preferences. Because we do not know in advance what these groups might be or even how many there are, we have no known outputs.

A final example could be detecting abnormal access patterns to a website. To identify abuse or bugs, it is helpful to find access patterns that differ from the norm. Each abnormal pattern might be unique, and we may not have any recorded instances of abnormal behavior. Since we only observe traffic without knowing what constitutes normal or abnormal behavior, this becomes an unsupervised problem.

For both supervised and unsupervised learning tasks, it is very important to have a representation of our input data that a computer can understand. Often, data is represented as a table so that each data point (email, customer, transaction, etc.) is a row, and each property or attribute that describes the data point (such as age, amount, or location) is a column.

In machine learning, each entity or row is known as a sample, while the columns (the properties that describe these entities) are called features.

This is something we are going to be working with in future sections of this course.