**Min-Max Scaling:-**

**Min-Max Scaling**, also known as **Normalization**, is another technique for scaling data. Unlike **Standard Scaling**, which transforms features to have a mean of 0 and a standard deviation of 1, **Min-Max Scaling** rescales the features to a fixed range, usually [0, 1], or another specified range.

**Key Concepts of Min-Max Scaling**

Min-Max Scaling transforms the feature values so that they fit within a specific range (typically [0, 1]). The transformation formula is:

scaled =

Where:

* is the original value of the feature.
* ) is the minimum value of the feature.
* is the maximum value of the feature.
* ​scaled is the rescaled value.

This formula linearly maps each value of the feature to the desired range, typically between 0 and 1.

**Why Use Min-Max Scaling?**

1. **Bounded Range**: Min-Max Scaling ensures that all values lie within a specific range (e.g., between 0 and 1). This is particularly useful when you need features to be on the same scale for certain algorithms that are sensitive to the scale of the input data.
2. **Good for Algorithms Sensitive to Magnitudes**: Algorithms that assume data is within a specific range or that rely on distances between data points (like **KNN**, **Neural Networks**, and **SVMs**) benefit from this kind of scaling.
3. **Preservation of Relationships**: Min-Max scaling preserves the relationships between the original data points and ensures the feature distribution stays proportional.

**When to Use Min-Max Scaling?**

* **When using algorithms like KNN, Neural Networks, and SVM**, which rely on the magnitude of values and distances between points.
* **When you want a feature’s values to be bounded**, typically between 0 and 1.
* **When your data has a known, fixed range** and you want to ensure that the transformed data fits within this range.

**Key Considerations with Min-Max Scaling:**

1. **Sensitivity to Outliers**:
   * Min-Max scaling can be very sensitive to outliers because the minimum and maximum values directly affect the scaling. If there are outliers, the entire feature will be scaled based on those outliers, which might compress most of the values into a small range.
   * In such cases, **Robust Scaling** or **Standard Scaling** may be better choices.
2. **Different Ranges**:
   * You can scale your data to a range other than [0, 1]. For example, some applications may need values to lie between [-1, 1] instead of [0, 1], and you can adjust the formula for that.