### Limitations of Multidimensional Scaling (MDS)

1. It relies on the distances between the data points to define the projection and does not consider other types of relationships between the data points, such as correlations or associations. This means that MDS may not be suitable for data sets that have complex, non-distance-based relationships, or that have missing or noisy distances.
2. It is sensitive to [outliers](https://www.geeksforgeeks.org/machine-learning-outlier/) and noise in the data, which can affect the quality of the projection and the interpretability of the results. MDS may produce projections that are distorted or misleading if the data contains outliers or noise, and may not accurately reflect the underlying structure of the data.
3. It is a global optimization technique, which means that it finds a single projection that is optimal for the entire data set. This can be problematic for data sets that have complex, multi-modal structures, or that have multiple clusters or groups of data points, as MDS may not be able to capture the local structure of the data within each group.
4. Lower capacity to deal with big datasets.

MDS is commonly compared to other dimensionality reduction techniques, such as principal component analysis (PCA) and t-distributed stochastic neighbor embedding (t-SNE), to understand how it differs from these techniques and when it may be more appropriate to use.

1. MDS is based on the concept of distance and aims to find a projection of the data that minimizes the differences between the distances in the original space and the distances in the lower-dimensional space. In contrast, PCA and t-SNE are based on the concept of variance and entropy, respectively, and aim to find a projection of the data that maximizes the variance or entropy in the lower-dimensional space. This means that MDS is more focused on preserving the relationships between the data points, while PCA and t-SNE are more focused on summarizing the data and finding the most relevant dimensions. MDS focus on distance relationship, PCA in variance, correlations.

2 MDS can be applied to a wide range of data types, including numerical, categorical, and mixed data. In contrast, PCA and t-SNE are more suited to numerical data, and may not be as effective with categorical or mixed data.

1. MDS uses numerical optimization algorithms **to find the projection that minimizes the stress function, and that best preserves the pairwise distances between the data points.** In contrast, [PCA](https://www.geeksforgeeks.org/implementing-pca-in-python-with-scikit-learn/) and [t-SNE](https://www.geeksforgeeks.org/ml-t-distributed-stochastic-neighbor-embedding-t-sne-algorithm/) use linear algebra and stochastic algorithms, respectively, **to find the projection that maximizes the variance or entropy in the lower-dimensional space.** This means that MDS is a more flexible and adaptable technique, and can find projections that are different from those produced by PCA or t-SNE.