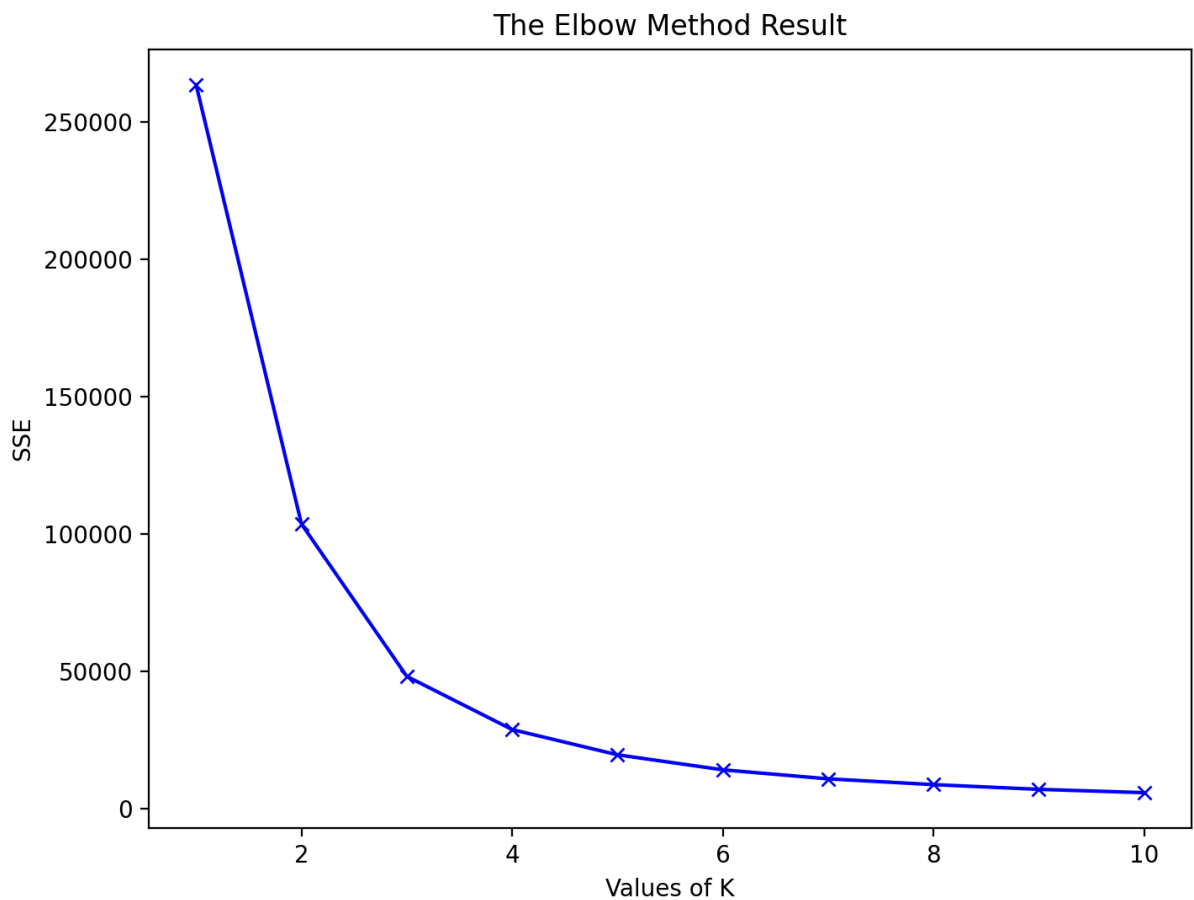
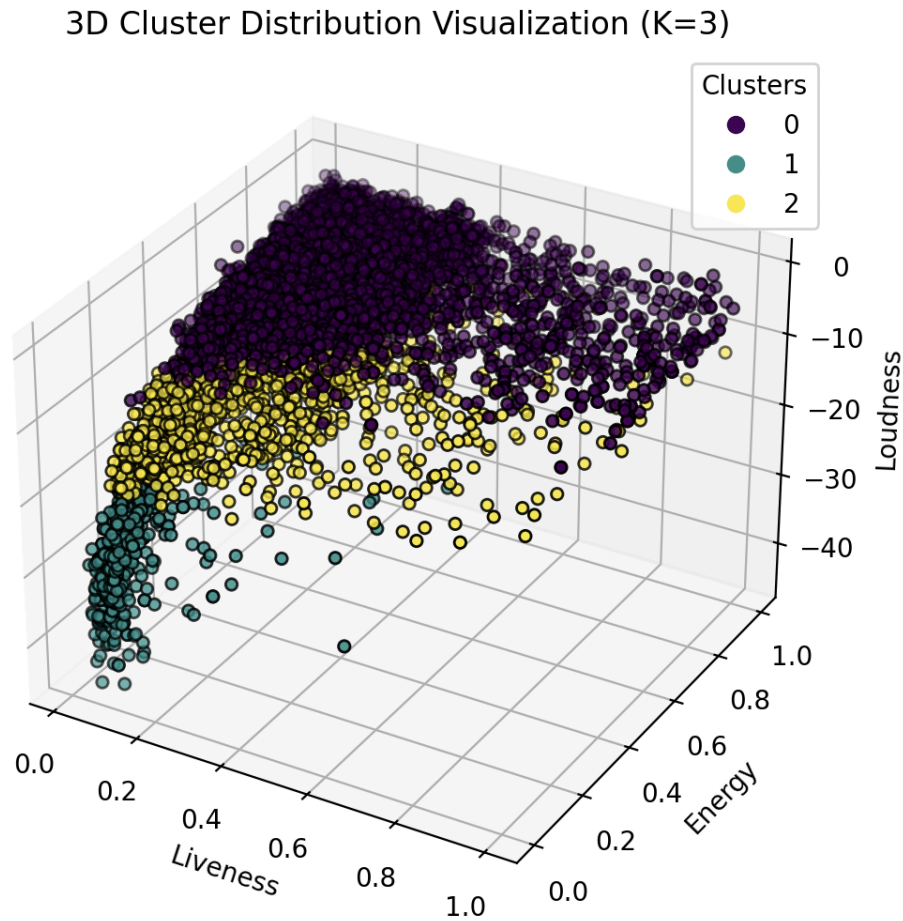


Part 1: Find the optimal K with elbow method and draw 3D map

- Load data and only keep the Liveness, Energy, Loudness these three variables.
- Applying elbow method to find the optimal k, here is 3, see the figure below



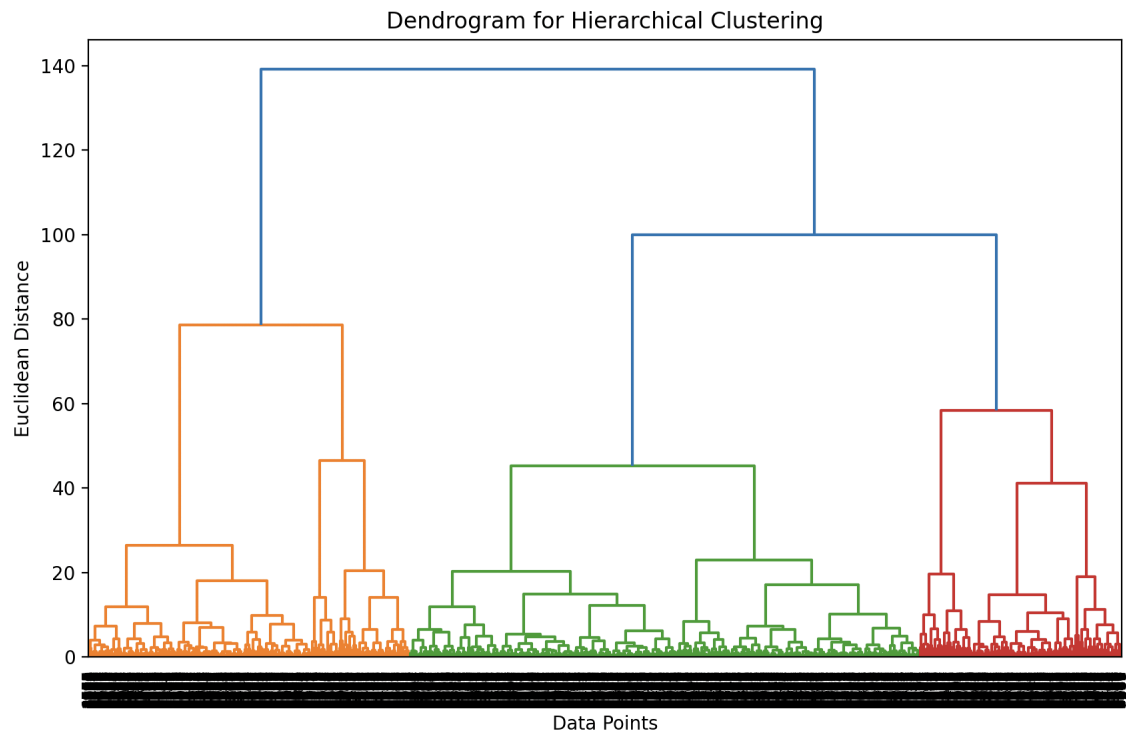
- After calculating optimal $k = 3$, draw the 3d map as x, y and z axis are Liveness, Energy, Loudness respectively.



- K-Means clustering results: there are 3 well-separated, compact groups representing 3 main different song styles.

Part 2: Hierarchical Clustering

- After applying dendrogram, it suggests three primary clusters, which is aligning with K-Means findings/elbow method before, see the figure below:



Findings:

- The Elbow method helps to find the optimal k , and K-Means provided structured clusters.
- Hierarchical clustering helps to find three main well-ranged groups, and it matches the optimal $k = 3$ we calculated earlier.

Conclusion: Both methods can help us to identify meaningful groupings in music data based on provided 3 variables.