CLUSTERING

Machine Learning for Autonomous Robots

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University of Bremen

German Research Center for Artificial Intelligence

Recap Questions

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- What are the advantages and drawbacks of k-means, GMM and DBSCAN?
- What are applications of clustering?

Implementation Task

Task

Download the Jupyter notebook from StudIP and solve the tasks described there: implement k-means.

Exploratory Data Analysis: Grasp Stability Estimation

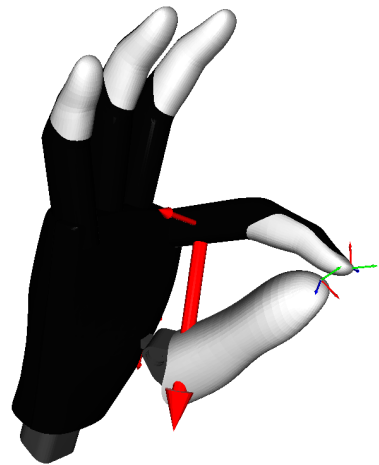
Clustering for Exploratory Data Analysis

Task: Grasp Stability Estimation

Grasp Stability Estimation

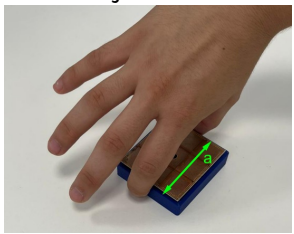
Available sensor data:

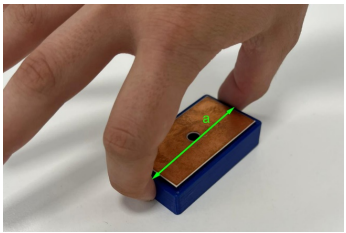
- Force measurements (normal and lateral force) in index finger, middle finger, and thumb
- Distances between tip of index finger and thumb, and between tip of middle finger and thumb
- . . . as time series

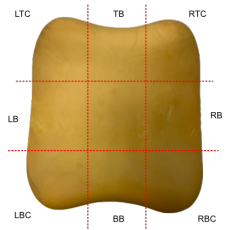


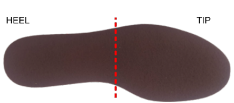
Grasp Stability Estimation

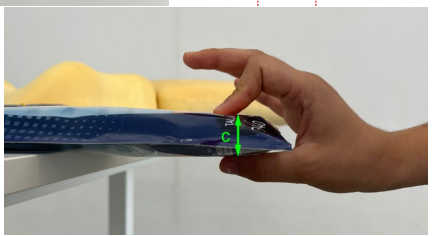
Other objects:











Grasp Stability Estimation

Questions:

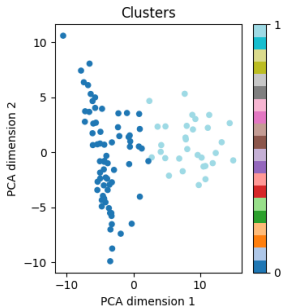
- Are there any natural groups (clusters) in the dataset?
- Would we be able to distinguish between stable and unstable grasps?
- Would we be able to distinguish between objects?

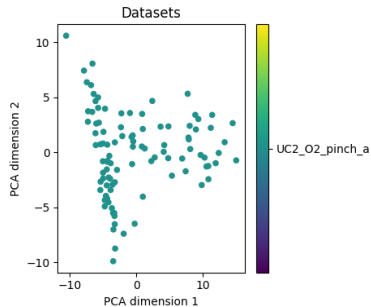
Problem:

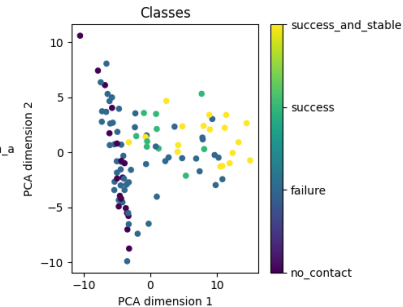
- Data is high-dimensional (80D) and not easy to visualize.
- We can use dimensionality reduction (e.g., principal component analysis) for visualization, but we will lose information.

Grasp Stability Estimation

k-means (k=2) before PCA to 2D, dataset visualized as scatter plot



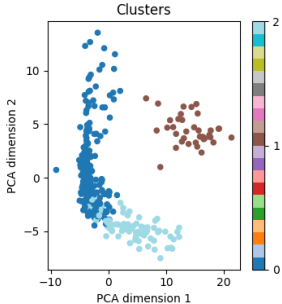


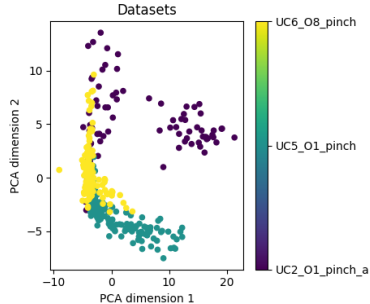


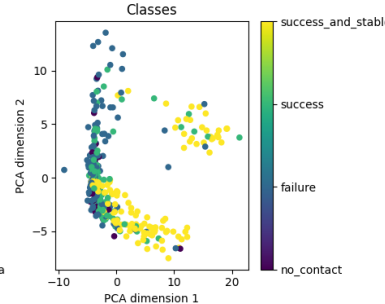
What do you observe?

Grasp Stability Estimation

GMM (3 Gaussians)







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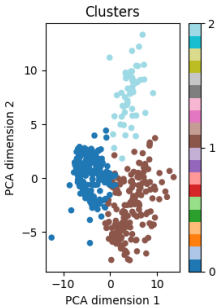
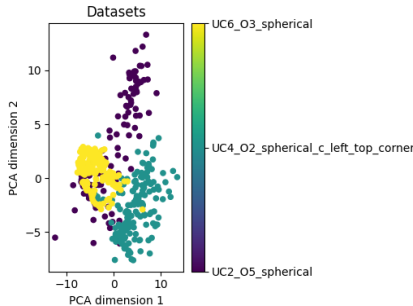
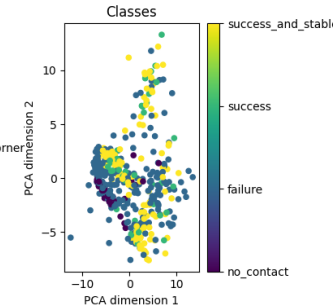
Grasp Stability Estimation

k-means (k=3)







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Download the Jupyter notebook from StudIP and solve the tasks described there: use k-means for document clustering.