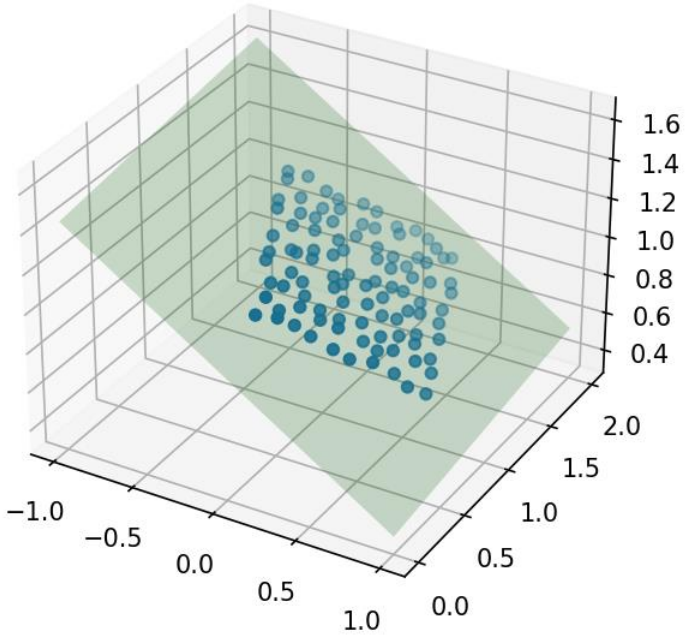
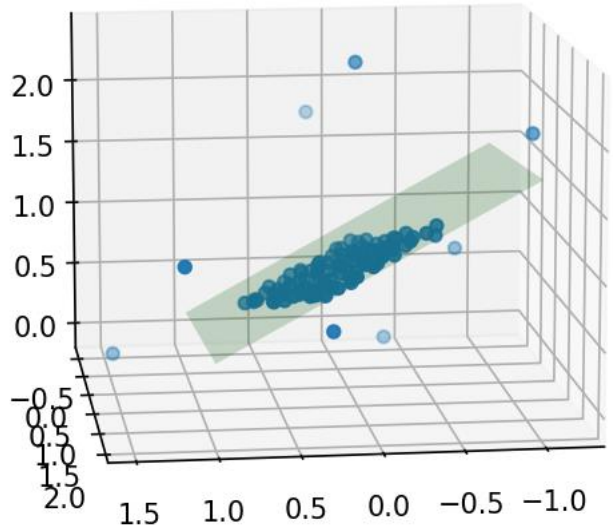
RSS HW4

Harin Kumar Nallaguntla (NUID: 002751978)
Programming Partners: Aditya Bondada, ManiChandan Chakinala

Q1. a) output of my code is:



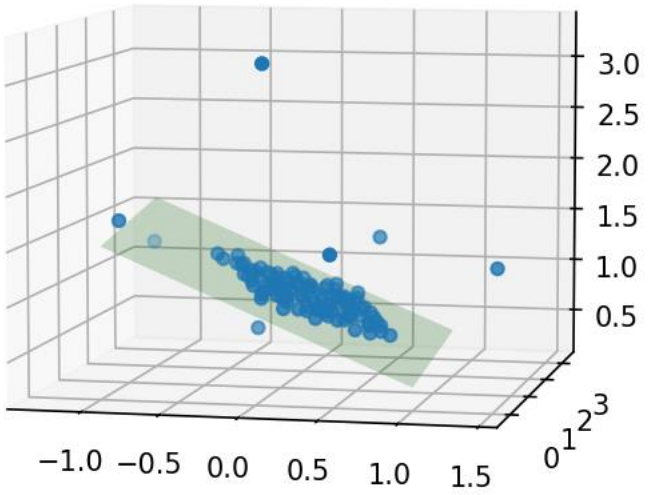
b) output of my code is:



The function fits a plane in (a) using the sample mean and covariance matrix of a collection of 100 points. The function can find the normal vector of the plane by looking at the eigenvectors of the covariance matrix. Calculating the mean of the points yields the plane's center point.

In (b), the function is assessed using a case in which the set of points contains outliers. The majority of the points and these outliers do not belong to the same plane. Because of these outliers, the mean and covariance matrix estimated from the full collection of points will be affected, and the center point and normal vector derived will be incorrect. This differs from the outcome of part (a), where the function assumed that all points were located on a single plane and thus, the normal vector and center point produced by the function should have precisely corresponded to that plane.

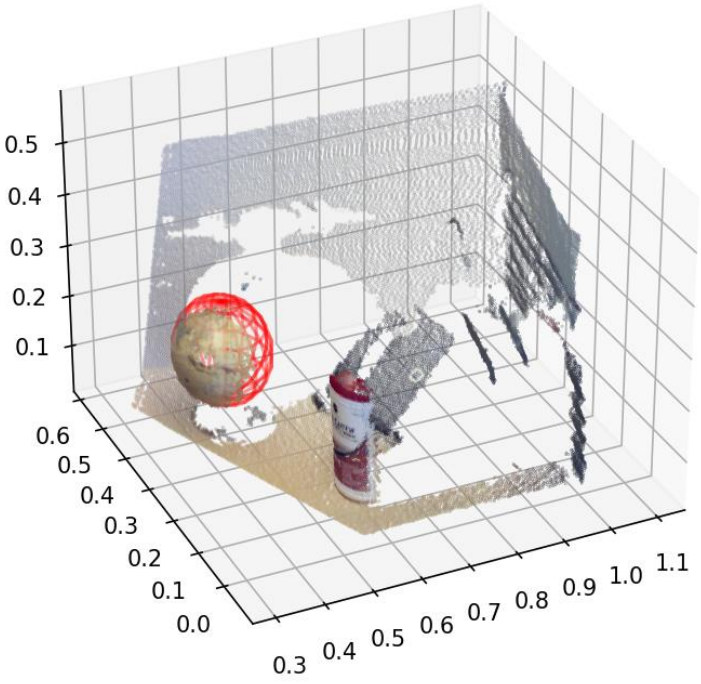
c)



The q1_a approach fits a plane by calculating the sample mean and covariance matrix of the points, assuming that the data is approximately Gaussian and the outliers are few and not too far from the plane. This approach is simple, fast, and works well when the data is clean and the noise level is low. However, it is not robust to outliers, as they significantly affect the sample mean and covariance matrix, leading to a plane that is not representative of the underlying data. This is because the sample mean and covariance matrix are sensitive to outliers, and do not have any mechanism to explicitly handle them.

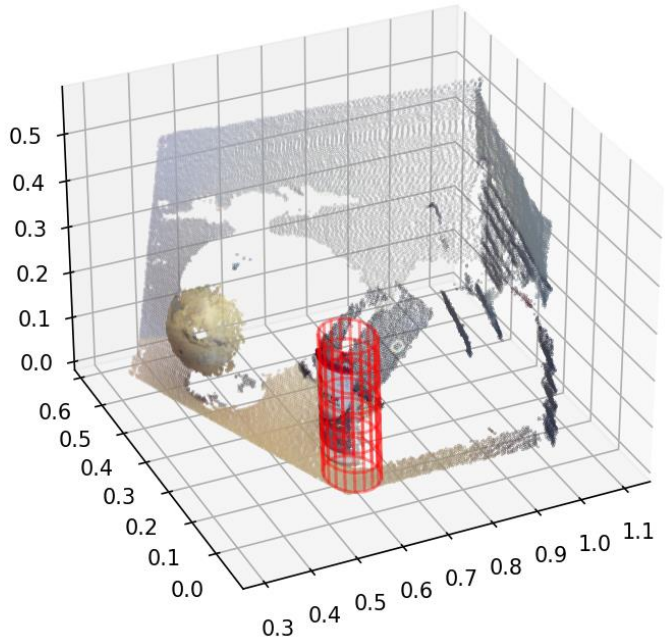
In q1_c, RANSAC algorithm is advantageous because it is less sensitive to outliers, making it useful when dealing with noisy data. However, it can be computationally expensive, particularly with large datasets, and the accuracy is dependent on the selection of appropriate parameters, such as the distance threshold.

Q2. output of my code is:



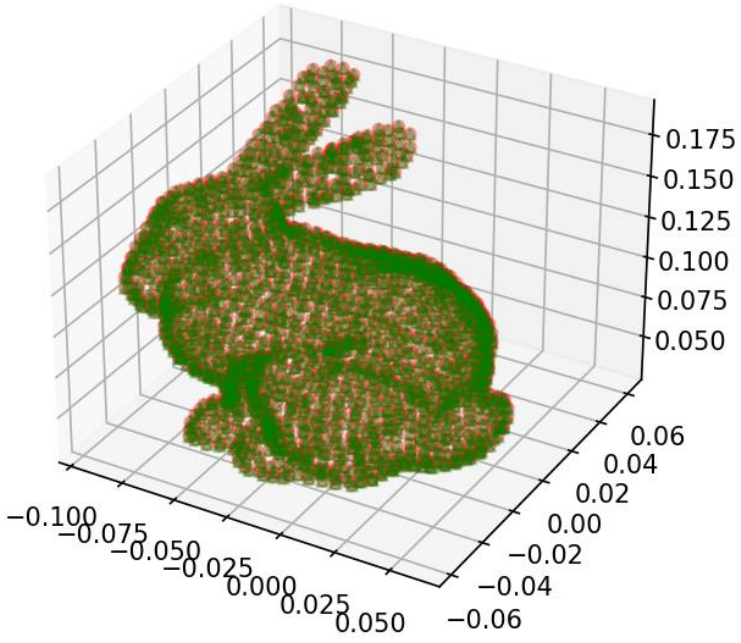
Parameters used for the RANSAC algorithm are: number of iterations = 1000 and distance threshold = 0.01

Q3.

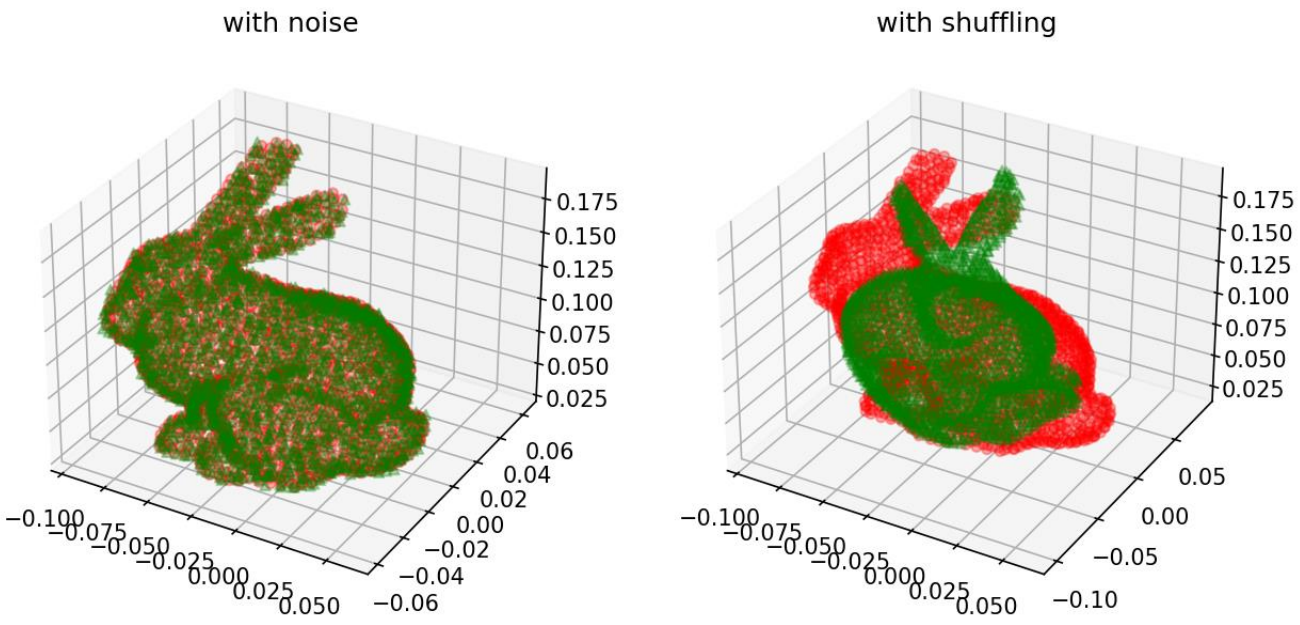


Parameters used for the RANSAC algorithm are: number of iterations = 5000 and distance threshold = 0.001

Q4. a)



b)



The ICP algorithm can handle Gaussian noise in one of the point clouds because it focuses only on the closest points between the two clouds and the overall structure of the point cloud is not affected by the noise. However, if the points in one of the clouds are shuffled, it may result in incorrect alignment since the closest points may not correspond to the same points. Therefore, the ICP algorithm depends on consistent correspondences between the two point clouds throughout the iterations, which cannot be guaranteed when the order of the points is shuffled.

c)