Iterative Closest Point Algorithm(ICP):

Aim: To find the optimal rotation and translation for a pair of rigidly transformed data using Iterative closest point algorithm.

Method:

1. Data is mean centered by subtracting the mean from each of the set of points.
2. A descriptor is used to find the initial set of corresponding points.
3. We then find the initial rotational matrix as VU^T where V and U are right and left singular vectors of XY^T (X,Y are a subset of the data points)
4. We then find the closest point on P for every point in Q and repeat (3)
5. The optimal rotational matrix is obtained as a product of rotational matrices in each step.
6. The optimal translational vector is obtained as $Q^m - R^{opt} P^m$. P^m and Q^m are the mean of the data points respectively.

Results:

1. For the points P1 and Q1 the optimal rotation and translation are:

```
R =

    0.7660   -0.0000   -0.6428
   -0.5826    0.4226   -0.6943
    0.2717    0.9063    0.3237
```

```
t =

    1.0000
    1.0000
    1.0000
```

2. For the points P2 and Q2 the optimal rotation and translation are:

```
R =

    0.1219    0.0000   -0.9925
   -0.0865    0.9962   -0.0106
    0.9888    0.0872    0.1214
```

```
t =

    1.0000
    1.0000
    1.0000
```

3. For the points P3 and Q3 the optimal rotational and translation:

```
R =

    0.9848   -0.0000   -0.1736
   -0.1632    0.3420   -0.9254
    0.0594    0.9397    0.3368
```

```
t =

    1.0000
    1.0000
    1.0000
```

4. For P4 and Q4 the optimal rotational and translation are:

```
R =

    0.1736   -0.0000   -0.9848
   -0.9848    0.0000   -0.1736
    0.0000    1.0000   -0.0000
```

```
t =

    1.0000
    1.0000
    1.0000
```

5. For the points P5 and Q5 the optimal rotation and translation are:

```
R =

    0.1737    0.0000   -0.9848
   -0.1710    0.9848   -0.0302
    0.9698    0.1736    0.1710
```

```
t =

    1.0500
    1.0500
    1.0498
```

6. For the points P6 and Q6 the optimal rotation and translation

```
R =

    0.1737    0.0000   -0.9848
   -0.9848   -0.0000   -0.1737
   -0.0000    1.0000    0.0000
```

```
t =

    1.0496
    1.0501
    1.0496
```

7. For the points P7 and Q7 the optimal rotation and translation

```
R =

    0.8661   -0.0004   -0.4998
   -0.4998   -0.0005   -0.8661
    0.0000    1.0000   -0.0007
```

```
t =

    1.6190
    1.6903
    1.7609
```

8. For the points P8 and Q8 the optimal rotation and translation

```
R =

    0.0027   -0.0013   -1.0000
   -0.1732    0.9849   -0.0017
    0.9849    0.1732    0.0025
```

```
t =

    2.4105
    2.5423
    2.1484
```

9. For the points P9 and Q9 the optimal rotation and translation:

```
R =

    0.7113   -0.0003   -0.7029
   -0.4969    0.7070   -0.5032
    0.4971    0.7072    0.5028
```

```
t =

    2.2805
    2.9047
    2.4675
```

10. For the points P10 and Q10 the optimal rotational and translation:

```
R =

    0.0002   -0.0014   -1.0000
   -0.1735    0.9848   -0.0014
    0.9848    0.1735   -0.0001
```

```
t =

    1.3120
    1.3898
    1.3122
```