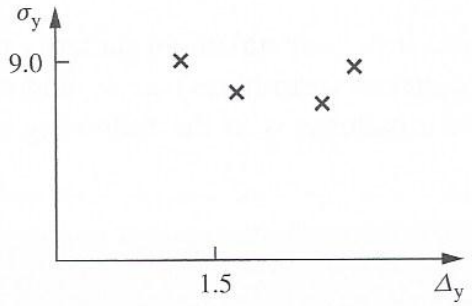
# AEEM 6097: Soft Computing Based AI
# Fall Semester 2019 – Dr. Kelly Cohen

## Assignment HW#6

Please note that while this problem is based on Problem 10.4 (Chapter 10) of the Ross text book, I have adapted it to best suit the needs of this class. Use MATLAB's, Fuzzy Logic Toolbox's, fcm algorithm and the Statistics Toolbox's kmeans algorithm as presented in class an included in Lessons L#10 & L#11.

Suppose we conduct a tensile strength test of four kinds of unidentified material. We know from other sources that the materials are from two different categories. From the yield stress, $\sigma_y$, and yield strain, $\Delta_y$, data, determine which materials are from the two different categories (Figure P10.4).

| | $m_1$ | $m_2$ | $m_3$ | $m_4$ |
|---|---|---|---|---|
| $\sigma_y$ | 8.9 | 8.1 | 7.3 | 8.3 |
| $\Delta_y$ | 1.4 | 1.6 | 1.8 | 1.9 |




a. Use fuzzy c-means (*fcm* algorithm) to determine the following: **(25 Points)**
   i. The coordinates of the two cluster centers
   ii. The membership grades for each of the data points
   iii. Plot the history of the objective function across the iterations.
   iv. Plot the clusters including the cluster centers

b. Use K-means (*kmeans* algorithm) to determine the cluster centers and plot them. **(15 points)**

c. Repeat procedure 50 additional times using both *fcm* and *kmeans* (each obviously will have another random initial condition) **and record the most 5 different cluster centers** and allocation of each material to a specific cluster in a table for each independent run. Fill the table provided in the next page: **(20 points)**

| | $C_1[\Delta_y]$ | $C_1[\sigma_y]$ | $C_2[\Delta_y]$ | $C_2[\sigma_y]$ | $m_1$ | $m_2$ | $m_3$ | $m_4$ |
|---|---|---|---|---|---|---|---|---|
| ***fcm* #1** | | | | | | | | |
| ***fcm* #2** | | | | | | | | |
| ***fcm* #3** | | | | | | | | |
| ***fcm* #4** | | | | | | | | |
| ***fcm* #5** | | | | | | | | |
| ***Kmeans*#1** | | | | | | | | |
| ***Kmeans*#2** | | | | | | | | |
| ***Kmeans*#3** | | | | | | | | |
| ***Kmeans*#4** | | | | | | | | |
| ***Kmeans*#4** | | | | | | | | |

d. Based on the results obtained thus far, discuss your observations **(15 points).**

e. What would you expect to see from the above two algorithms if the measurement errors for both the stress and the strain was ±10%. Discuss your prediction concerning the sensitivity to noise. Feel free to support your statement by running a few cases with sensor noise **(15 points)**.

f. Attach your m-file **(10 points)**