Queen Mary
University of London

MTH793P **Advanced Machine Learning, Semester B, 2023/24**

Coursework 3

---

1 k-means clustering

1. Perform two steps of k-means clustering by hand for the ten data points $x_1 = -3$, $x_2 = 2$, $x_3 = -1$, $x_4 = 7$, $x_5 = 11$, $x_6 = 6$, $x_7 = -30$, $x_8 = 0$, $x_9 = -50$ and $x_{10} = 15$. Assume $k = 3$ clusters and initialise your centroids as $\mu_1^0 = -4$, $\mu_2^0 = 0$ and $\mu_3^0 = 1$, respectively

$$\mu^0 := \begin{pmatrix} -4 & 0 & 1 \end{pmatrix} .$$

   For each iteration update the assignment variable z^l first, and then μ^l. Here $l \in \{1, 2\}$ denotes the iteration index.

2. Did the method converge after two iterations?

3. Perform k-means clustering by hand for the five data points

$$x_1 = \begin{pmatrix} -3 \\ 6 \end{pmatrix} , x_2 = \begin{pmatrix} 2 \\ -30 \end{pmatrix} , x_3 = \begin{pmatrix} -1 \\ 0 \end{pmatrix} , x_4 = \begin{pmatrix} 7 \\ -50 \end{pmatrix} \quad \text{and} \quad x_5 = \begin{pmatrix} 11 \\ 15 \end{pmatrix} .$$

   Assume $k = 3$ clusters and initialise your centroids as

$$\mu_1^0 := \begin{pmatrix} -1 \\ 1 \end{pmatrix} , \mu_2^0 := \begin{pmatrix} 3 \\ -5 \end{pmatrix} \quad \text{and} \quad \mu_3^0 := \begin{pmatrix} 10 \\ 15 \end{pmatrix} .$$

   Perform as many iterations as are required to guarantee convergence.