Question1. Please answer the following questions about linear regression. (**15 marks**)

1. Explain the relationship between residuals and the cost function in linear regression. (**5 marks**)
2. Briefly introduce why gradient descent could help us identify the parameters in linear regression. (**5 marks**)
3. When working with high-dimensional input data (a large number of features), which method is more suitable for optimizing parameters: the normal equation or gradient descent? Justify your choice. (**5 marks**)

Question 2. In the table below, we showed key details for 10 employers in the company. (**55 marks**)

Employer ID	Department	Working hours per week	Salary per week (HKD)	Rank level
1	Human Resources	38	5,000	B
2	R&D	65	15,000	B
3	Sales	42	6,000	B
4	R&D	72	20,000	A
5	R&D	68	10,000	C
6	Sales	48	5,500	B
7	Sales	60	7,500	B
8	Human Resources	39	6,000	B
9	Human Resources	41	10,000	A
10	R&D	65	25,000	A

2.1. According to the information shown in the table, calculate median, Q1, Q3 and IQR of "Salary per week" for the employers. Which statistics are outlier resistant? Are there any outlier points? (**20 marks**)

2.2. Normalize the "Working hours per week" of **Employer 1** using z-score normalization and decimal scaling. (**15 marks**)

2.3. Use smoothing by bin means to smooth "Working hours per week" using **equal-width** binning with 2 bins. Show your steps. (**20 marks**)
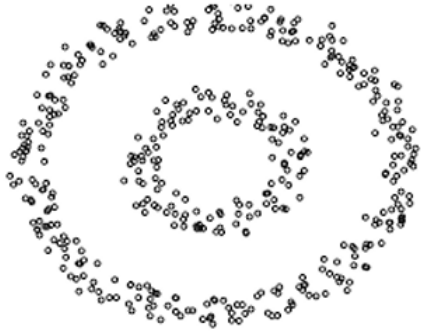
Question 3. Please answer the following questions (**15 marks**)

3.1 How do you choose the regularization parameter **C** in SVM? (**5 marks**)

3.2. Can both Perceptron and SVM handle non-linear data? (**5 marks**)

3.3. When would you use a Perceptron over an SVM? (**5 marks**)

Question 4. Given the following dataset, does K-Means work well on it? Justify your answer. (**5 marks**)

Question 5. Why is K-Means sensitive to initial centroid placement? **(5 marks)**

Question 6. How do K-Means and KNN handle noise and outliers differently? **(5 marks)**