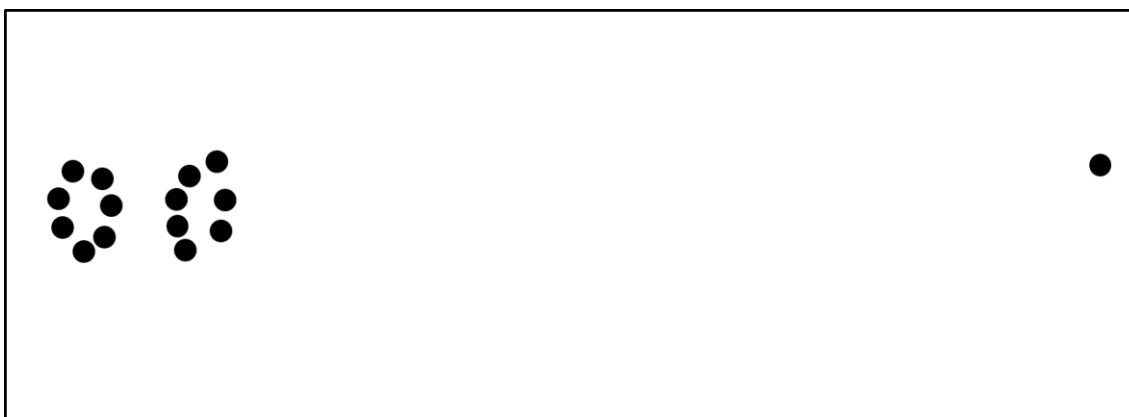


Computer Vision: Assignment #4

Due 13 May 2015

1. We observe points. Those points are modeled as being generated from a number of squares, whose sides are aligned with x and y axes and have the same length L . Describe a Hough transform algorithm to detect the numbers of the squares and the center of each square.
2. Consider the following 2D data.



- (a) What do you expect to happen if we run the K-means algorithm ($K = 2$) on this data set?
 - (b) Suggest a way to resolve this problem.
3. Suppose that the K-means algorithm partitions a 2-D plane into four clusters. The converged cluster centers are $(-1, 0)$, $(1, 1)$, $(1, -1)$, $(2, 0)$. From the cluster centers, it can be inferred that the cluster boundaries are given by five line segments. Draw them and specify the slope of each line segment.
 4. Given observation points $(0, 1)$, $(1, 2)$, $(2, 5)$, $(-1, 2)$, $(-2, 4)$, we want to fit them with a curve $y = ax^2 + b$. Find the optimal parameters a and b using the least square fitting.
 5. If A is a symmetric matrix, $\frac{\partial}{\partial \mathbf{x}}(\mathbf{x}^T A \mathbf{x}) = 2A\mathbf{x}$. What is $\frac{\partial}{\partial \mathbf{x}}(\mathbf{x}^T A \mathbf{x})$, if A is not symmetric?
 6. $x^2 + 2y^2 + 3z^2 = 1$. What is the maximum of $x + y + z$?
 7. Given observation points $(0, 1)$, $(\frac{\pi}{2}, 2)$, $(-\frac{\pi}{2}, -1)$, $(\pi, 3)$, $(\frac{3\pi}{2}, 0)$, we want to fit them with a curve $y = a \cdot \sin x + b$. Find the optimal parameters a and b using the least square fitting.