CS 675 – Computer Vision – Fall 2007

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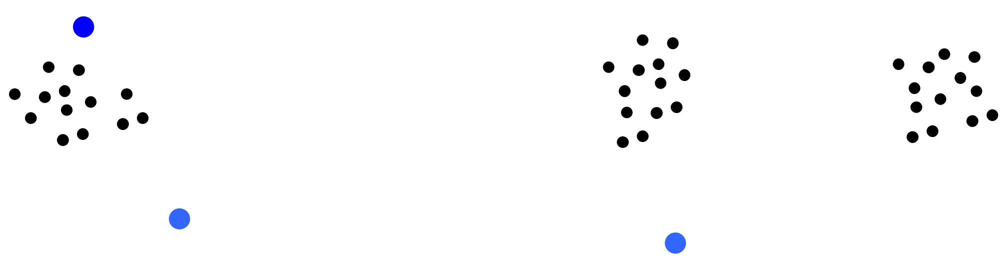
Assignment #4

Sample Solutions

Question 2.

Assume that we would like to partition a given data set into three clusters. Below you see that dataset, together with the three randomly chosen starting positions of the cluster centers a, b, and c (large blue dots):



After the algorithm converges, the center may be positioned like this:

This means that the first two clusters will be taken from the leftmost group of data points, and the third cluster will include both groups of data points on the right. This is clearly undesirable from the human observer's perspective. It would be much more plausible to assign each of the three groups to an individual cluster. However, if the starting positions of the cluster happen to be unfavorable, these things can actually happen – this is not an overly constructed example.

Question 3(a). The five frames are shown below.

0	0	0	0	0	0	0	0
0	100	100	0	0	0	0	0
0	100	100	0	0	0	0	0
0	0	0	0	0	0	0	0

0	0	0	0	0	0	0	0
0	0	100	100	0	0	0	0
0	0	100	100	0	0	0	0
0	0	0	0	0	0	0	0

0	0	0	0	0	0	0	0
0	0	0	100	100	0	0	0
0	0	0	100	100	0	0	0
0	0	0	0	0	0	0	0

0	0	0	0	0	0	0	0
0	0	0	0	100	100	0	0
0	0	0	0	100	100	0	0
0	0	0	0	0	0	0	0

0	0	0	0	0	0	0	0
0	0	0	0	0	100	100	0
0	0	0	0	0	100	100	0
0	0	0	0	0	0	0	0

Since Columns 0 and 7 don't change, nor do Rows 0 and 3, we only care about the Rows 1 and 2, in Columns 1 through 6. Using the formula from Slide 9 from Lecture 9, with $a_1 = 0.2$, $a_2 = 0.4$, $a_3 = 0.6$, $a_4 = 0.8$, and $a_5 = 1.0$:

$d_{cum}(1, 1) = d_{cum}(2, 1) = (0.2 \cdot 0) + (0.4 \cdot 100) + (0.6 \cdot 100) + (0.8 \cdot 100) + (1.0 \cdot 100) = 280$
$d_{cum}(1, 2) = d_{cum}(2, 2) = (0.2 \cdot 0) + (0.4 \cdot 0) + (0.6 \cdot 100) + (0.8 \cdot 100) + (1.0 \cdot 100) = 240$
$d_{cum}(1, 3) = d_{cum}(2, 3) = (0.2 \cdot 0) + (0.4 \cdot 100) + (0.6 \cdot 100) + (0.8 \cdot 0) + (1.0 \cdot 0) = 100$
$d_{cum}(1, 4) = d_{cum}(2, 4) = (0.2 \cdot 0) + (0.4 \cdot 0) + (0.6 \cdot 100) + (0.8 \cdot 100) + (1.0 \cdot 0) = 140$
$d_{cum}(1, 5) = d_{cum}(2, 5) = (0.2 \cdot 0) + (0.4 \cdot 0) + (0.6 \cdot 0) + (0.8 \cdot 100) + (1.0 \cdot 100) = 180$
$d_{cum}(1, 6) = d_{cum}(2, 6) = (0.2 \cdot 0) + (0.4 \cdot 0) + (0.6 \cdot 0) + (0.8 \cdot 0) + (1.0 \cdot 100) = 100$

Entering these values into the cumulative difference image/matrix yields:

0	0	0	0	0	0	0	0
0	280	240	100	140	180	100	0
0	280	240	100	140	180	100	0
0	0	0	0	0	0	0	0

Question 3(b). The three frames are shown below.

0	0	0	0	0	0	0	0
0	100	100	0	0	0	0	0
0	100	100	0	0	0	0	0
0	0	0	0	0	0	0	0

0	0	0	0	0	0	0	0
0	0	0	100	100	0	0	0
0	0	0	100	100	0	0	0
0	0	0	0	0	0	0	0

0	0	0	0	0	0	0	0
0	0	0	0	0	100	100	0
0	0	0	0	0	100	100	0
0	0	0	0	0	0	0	0

This time, the values of columns 1 and 2 will be the same, as will 3 and 4, and 5 and 6; while $a_1 = 0.2$, $a_2 = 0.4$, and $a_3 = 0.6$.

$d_{cum}(1, 1) = d_{cum}(2, 1) = d_{cum}(1, 2) = d_{cum}(2, 2) = (0.2 \cdot 0) + (0.4 \cdot 100) + (0.6 \cdot 100) = 100$
$d_{cum}(1, 3) = d_{cum}(2, 3) = d_{cum}(1, 4) = d_{cum}(2, 4) = (0.2 \cdot 0) + (0.4 \cdot 100) + (0.6 \cdot 0) = 40$
$d_{cum}(1, 5) = d_{cum}(2, 5) = d_{cum}(1, 6) = d_{cum}(2, 6) = (0.2 \cdot 0) + (0.4 \cdot 0) + (0.6 \cdot 100) = 60$

Entering these values into the cumulative difference image/matrix yields:

0	0	0	0	0	0	0	0
0	100	100	40	40	60	60	0
0	100	100	40	40	60	60	0
0	0	0	0	0	0	0	0