

NO MORE LATE DAYS LEFT

CIS419 Machine Learning

Assignment V Part I

James Wang
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PennKey: jamwang
PennID: 46576241

Part I: Problem Set

1 K-Means

a)

x	1	2	3	4	9	12	6	10	9
$(x - 2)^2$	1	0	1	4	49	100	16	64	49
$(x - \frac{25}{3})^2$	54	40	28	19	0	13	5	3	0

Orange = Cluster 1

Green = Cluster 2

1st Iteration:

Cluster 1 = {1,2,3} → Centroid = 2

Cluster 2 = {4,9,12,6,10,9} → Centroid = $\frac{25}{3} = 8.33$

Update:

x	1	2	3	4	9	12	6	10	9
$(x - 2)^2$	1	0	1	4	49	100	16	64	49
$(x - \frac{25}{3})^2$	54	40	28	19	0	13	5	3	0

2nd Iteration:

Cluster 1 = {1,2,3,4} → Centroid = 2.5

Cluster 2 = {9,12,6,10,9} → Centroid = 9.2

Update:

x	1	2	3	4	9	12	6	10	9
$(x - 2.5)^2$	2	0	0	2	42	90	12	56	42
$(x - 9.2)^2$	67	52	38	27	0	8	10	1	0

3rd Iteration:

Cluster 1 = {1,2,3,4} → Centroid = 2.5

Cluster 2 = {9,12,6,10,9} → Centroid = 9.2

- b) Yes, because the centroids no longer move, due to the fact that each point has been assigned to the cluster of its closest centroid, and thus the centroids no longer need to be re-estimated.

2 K-Means and Variance

- a) The variance of a partition decreases as you increase the value of K because this increases the number of clusters which means each point is no closer to a centroid and thus each partition has less variance.
- b) When $k = n$, then the variance in each partition is zero, because each point is now a centroid and therefore since the distance from each point to itself is zero, the variance of each partition will also be zero.

(see next page)

3 Reinforcement Learning I

The problem most likely lies in the size and structure of your maze. It is very likely there are infinite state sequences for this maze. In this case, the reward function is fine, however, you would need to either terminate the episodes after a certain number of steps, or set a time limit for each episode. This way, the robot will only have to search through a finite horizon and thus is more likely to come upon the exit of the maze and receive the +1 reward.

However, searching a finite horizon still might take awhile. You can also consider refining your reward function to communicate the goal more effectively with the robot/agent. This can be done by setting intermediary goals (i.e. sub-goals) along the correct path(s) of the maze to help the robot learn the optimal path faster.

(see next page)

Part II: Programming Exercises

1 Image Segmentation with K-Means

