

CMP SC 8001 - Vision Computing

Assignment 4

Interactive K-Means Clustering Using Qt

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Due: Monday, May 10, 2021

Introduction

For this assignment, we are going to implement the K-Means clustering algorithm with interactive visualization of the clustering process in both 2D and 3D. For the result, the color of each point should be related to the color of the closest centroid. User to choose distance method: l1-norm, l2-norm, or l-infinity-norm. For the center initializing method, user could choose random_real, random_sample, or k-means++. This program could visualize the changes of each iteration. User could go forward or backward of iterations.

User Interface

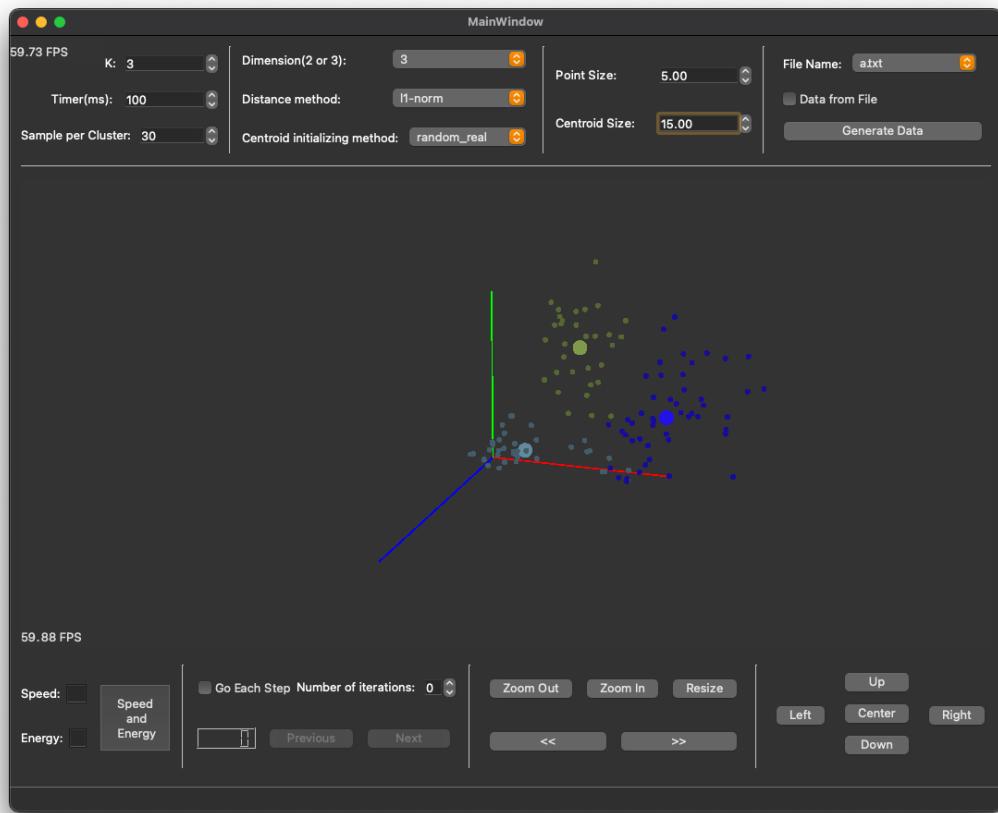
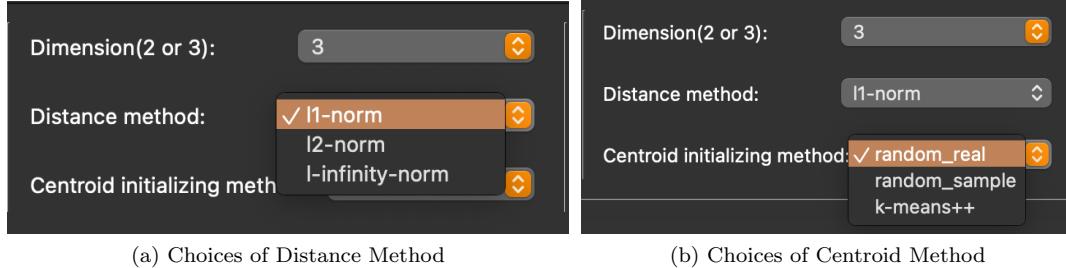


Figure 1: GUI for the program

For the layout of the GUI, on the left top section, users can decide

- the number of cluster K (range:[2, 99999])
- the Timer (for the duration between iterations, range:[100, 10000] ms)
- Sample per Cluster (When randomly generate data, range:[10, 1000])

Second section on top, the dimension can be chose by 2 or 3. The distance method and Centroid initialiing method have fixed choices.



For the rest of part on top, point size and center size could be changed by user. If user want to generate data from files, first need to check "Data From File", then, choose the txt file name. Once the "Data from File" checkbox is enabled, the data will not be generated by random. The choices of text file could be:

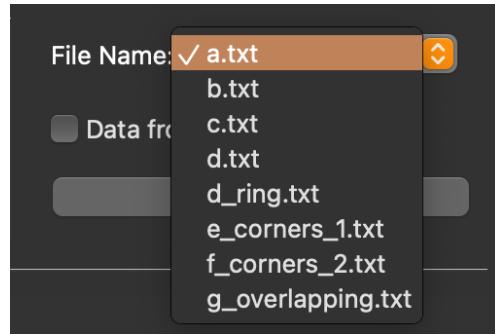


Figure 2: File list

The center part is the ViewWidget which displays the process of the project. For the first block at bottom, once the K-Means is done, user can click "Speed and Energy button" to display the value. If user wants to step thru each iteration, the "Go Each Step" checkbox should be enabled, and choose the number of iteration. The digital display box shows the current iteration. The [Previous] and [Next] button will be disabled when step to end-iterations.

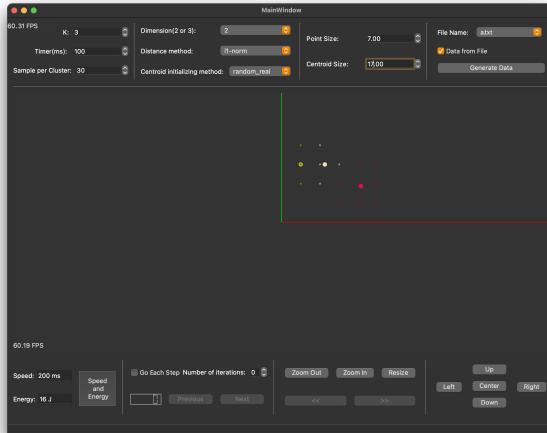
The right half side of bottom operation area is controlling the view. User can zoom in, zoom out, or go back to original position. The buttons [<<] and [>>] allow user to rotate the view by {0.5, 1.0, 0.5}. The Up, Down, Left, Right, and Center buttons control the position of **The eye**.

Experiments

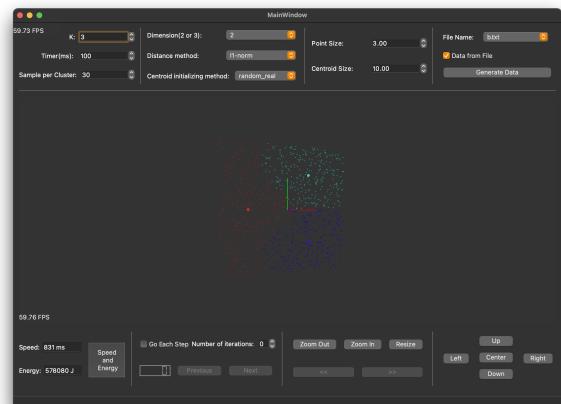
Run the data from Files

The first experiment is run the data from text files which meet requirement [7].

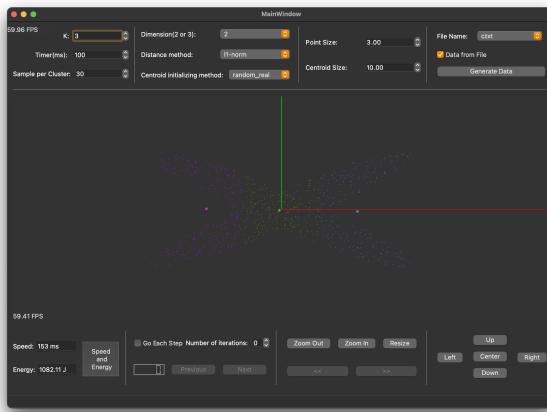
Test case a to d-spin



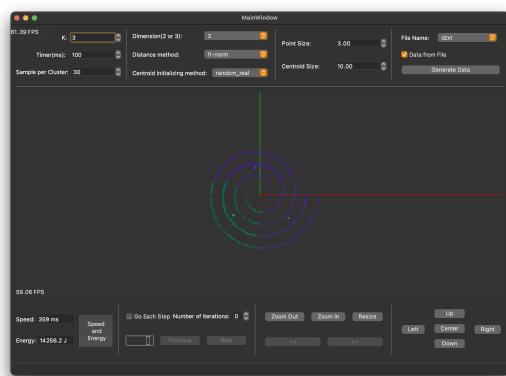
(a) Test Case a



(b) Test Case b

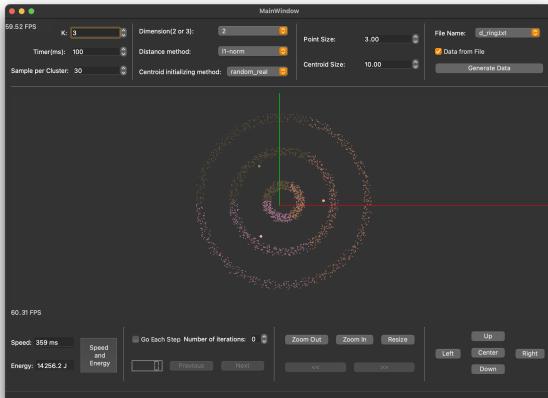


(c) Test Case c

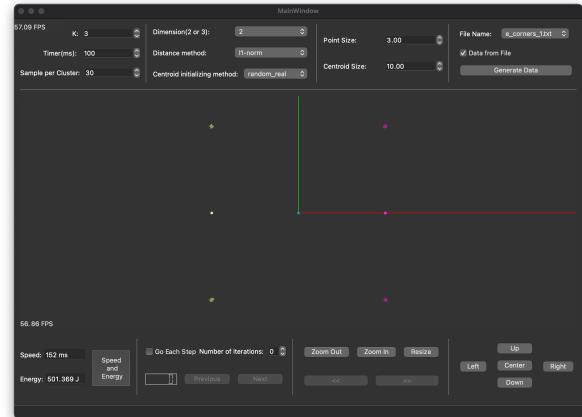


(d) Test Case d - spin

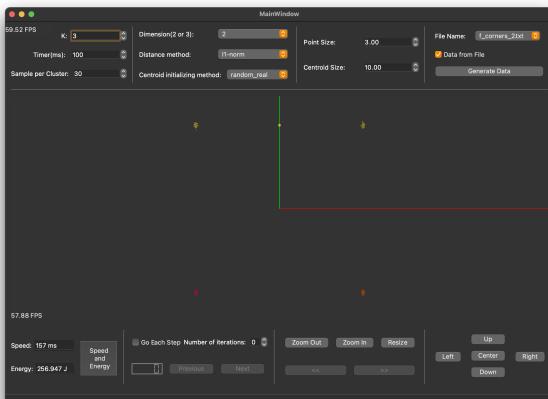
Test case d-ring to g



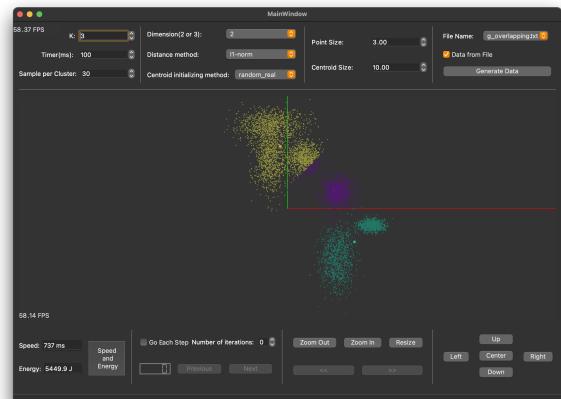
(a) Test Case d - ring



(b) Test Case e



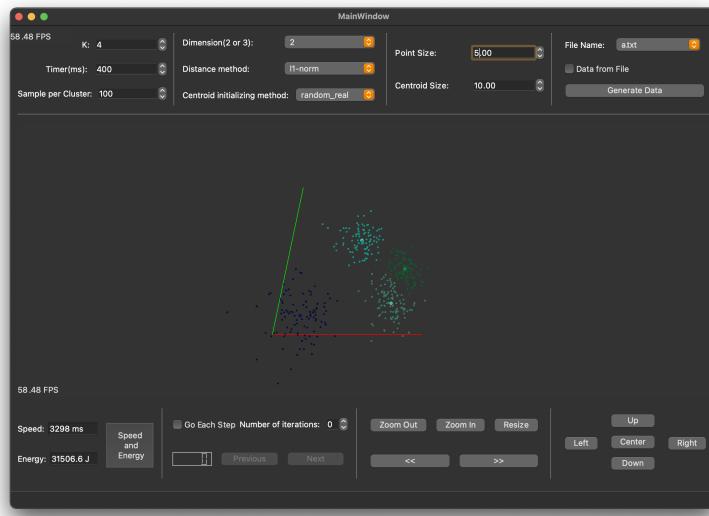
(c) Test Case f



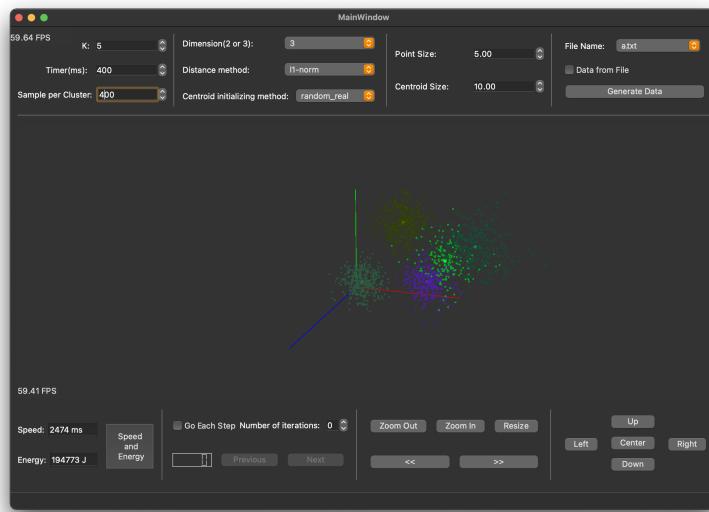
(d) Test Case g

Generate Data Randomly

Random 2D - 4 Clusters:

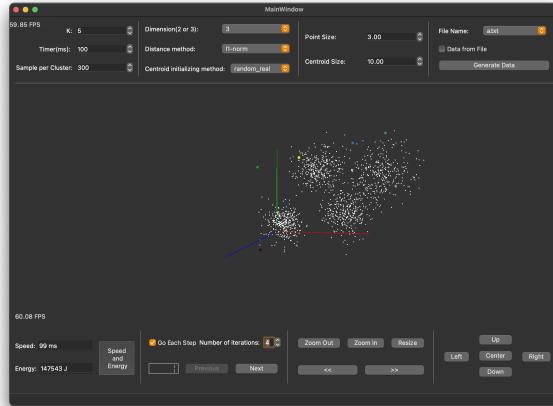


Random 3D - 5 Clusters:

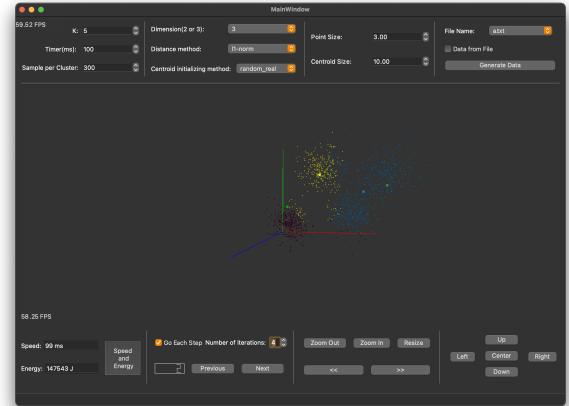


Step Thru Iterations

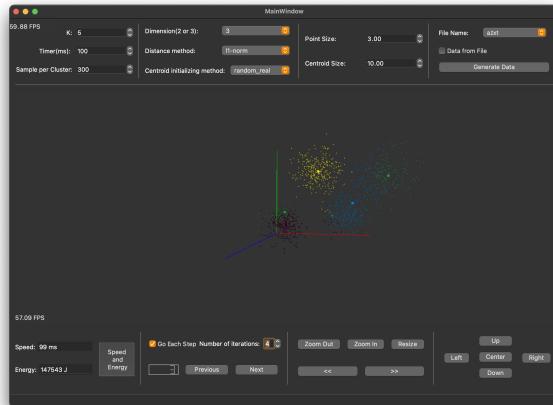
5 Clusters, 300 samples per cluster, 3D, 4 iterations



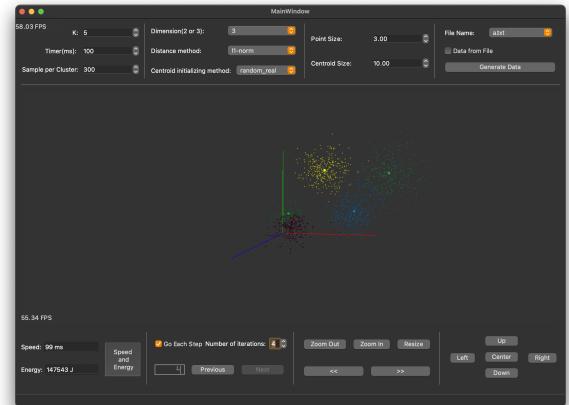
(a) Iteration - 1



(b) Iteration - 2



(c) Iteration - 3



(d) Iteration - 4

Speed & Energy Comparison

Test Case: d_ring.txt

- random_real - Speed: 755 Energy: 26418.4
- random_sample - Speed: 652 Energy: 26450
- k-means++ - Speed: 417 Energy: 25991.7