# COMP3323: Advanced Database Systems

## Assignment 3 Report (6 Pages)

***Q. Please write down your experiment environments (e.g., machine used, CPU speed, disk speed, main memory sizes).***

A.

- **Machine used:** MacBook Pro 13-inch (2018)
- **CPU speed:** 2.3 GHz
- **Disk speed:**
  - Write speed: 2,627MB/s
  - Read speed: 2,505MB/s
- **Main memory sizes:** 8 GB 2133 MHz

The code was written in Java 8 and the IDE used was Eclipse.

*Q.* ***Why is it possible to skip the cell c if dlow(c)>t?***
*(where dlow(c) smallest distance from q to cell c, t is the k-th largest distance in the k-NN set)*

A. We are trying to find the nearest k neighbours for point q. As we know that t is currently the distance of neighbour that is furthest away from q, if the shortest distance between cell c and point q is greater than t, then any point inside the cell c has to have distance greater than t and hence, the whole cell c can be ignored.

*Q.* ***Explain why pruning an entire layer of cells is sufficient to terminate the algorithm?***

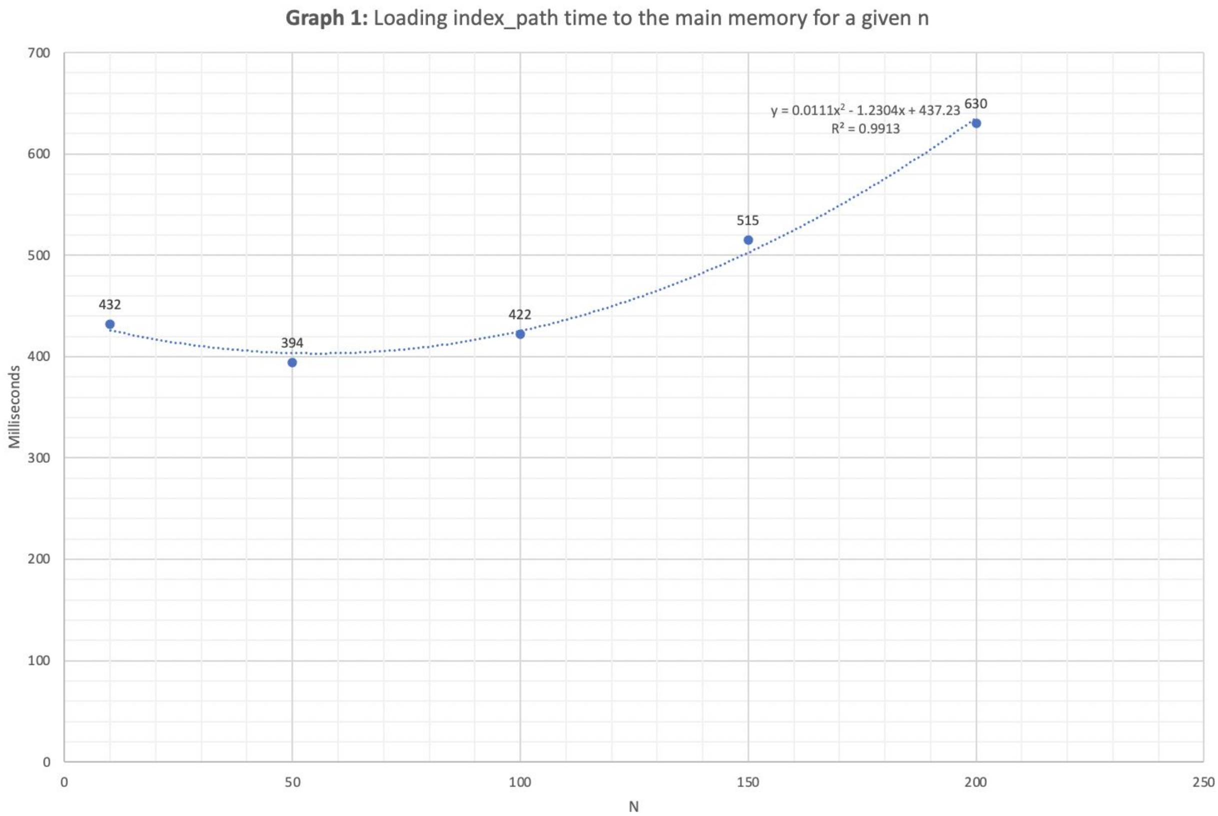
A. If we have checked a whole layer with no cell satisfying the condition of dlow(c) <= t, then, any next layer would only be further away from point q. Hence, we can terminate the whole algorithm.

*Q.* ***Perform the following experiments: (Hint: you can combine part c and d into one graph.)***

A. Generate 100 random query points within maxBox.

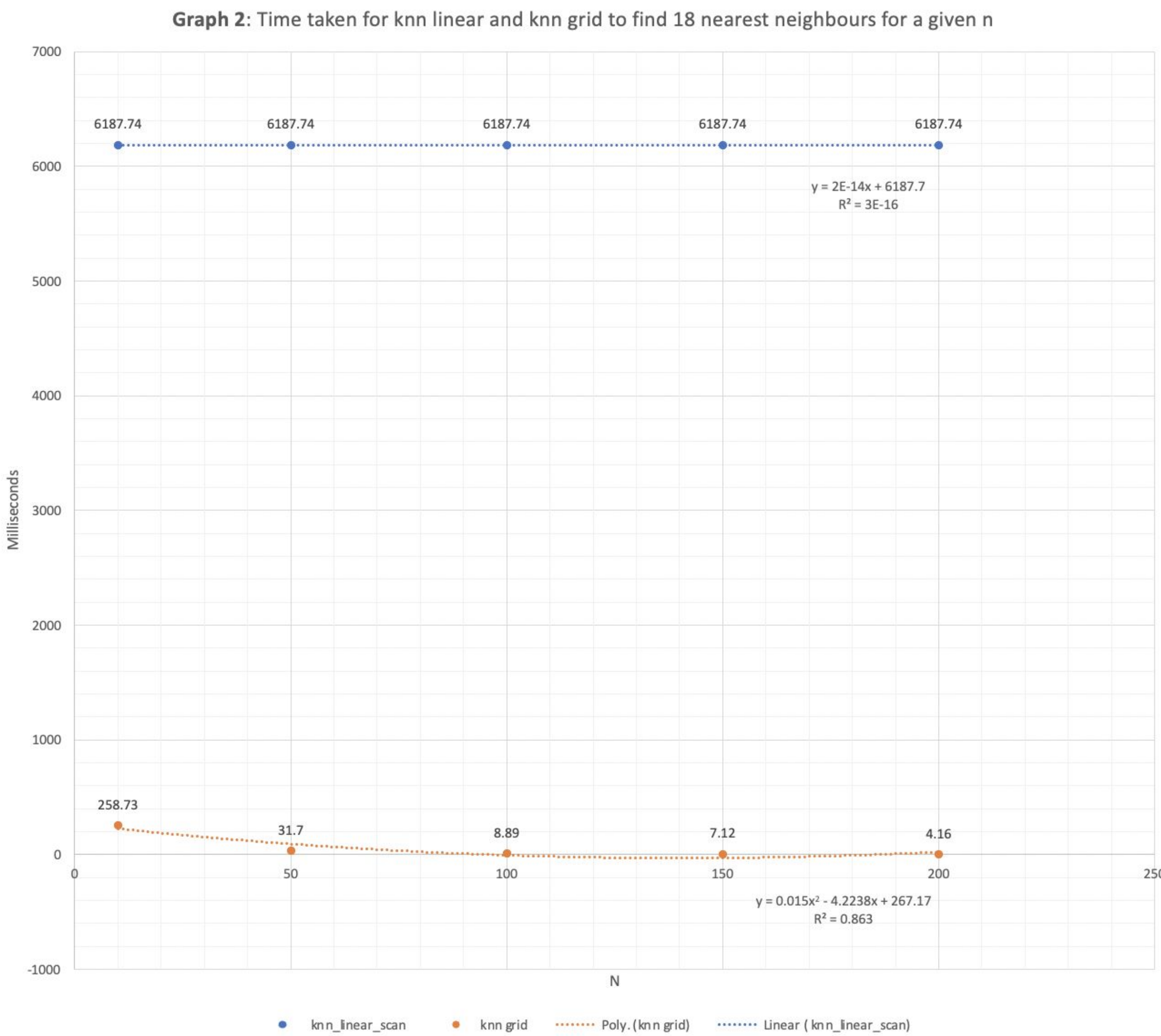
   *Please see the* ***appendix***

B. <u>Plot a line graph to show the time of loading “index_path” to the main memory, the following value of n: 10, 50, 100, 150, 200.</u>



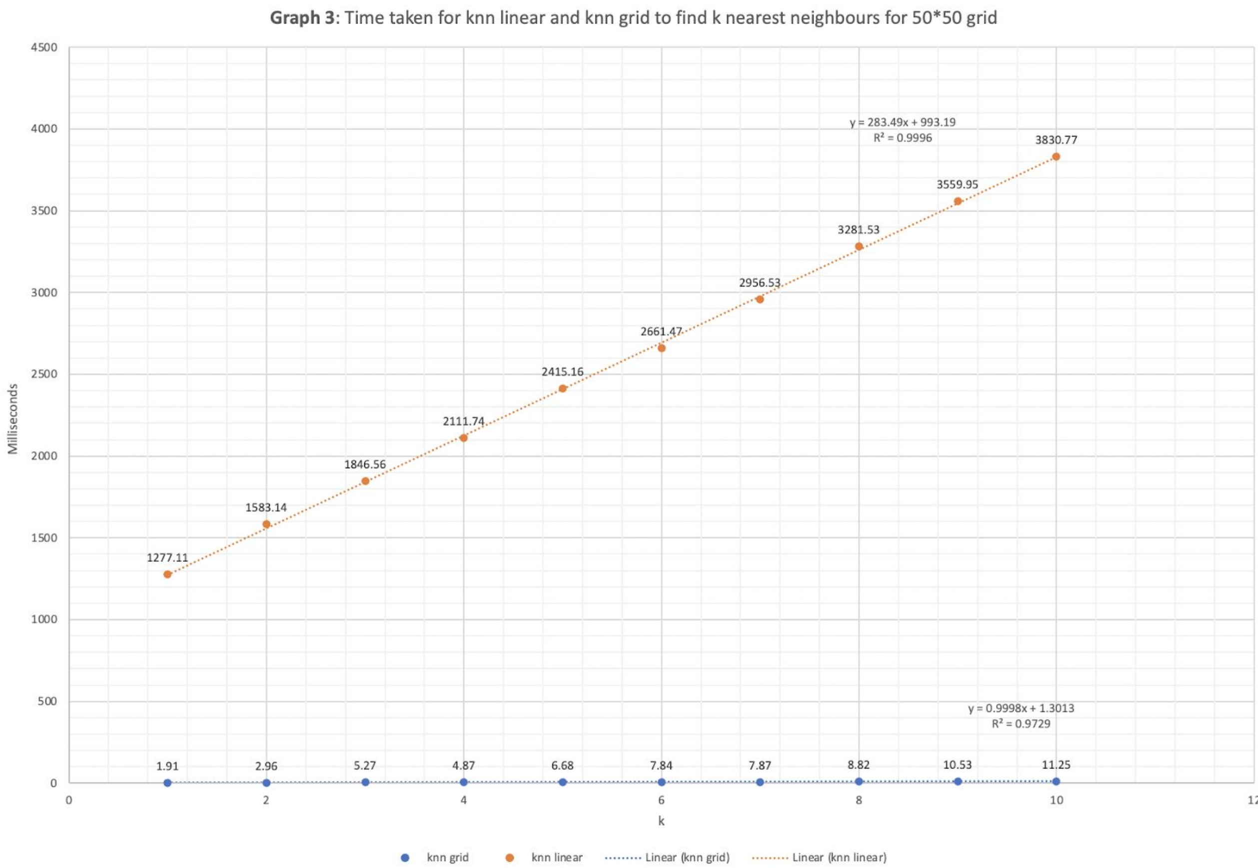

A. The structure used for “index_path” is a 2D arraylist ( e.g. Cell [Row][Column] - see Fig 1 ). For small values of n (e.g. 10), we have relatively few references to the 1D array containing many points. Hence, it takes more time to load “index_path”. But as you keep increasing the value of n, the references are increasing slightly compared to the reduction in the size of 1D arraylist containing the points and hence, the time to load decreases. After n = 50, the trade off of increasing references to decrease 1D arraylist sizes is lost and increasing references not only adds more time but does not decrease the size of the 1D array significantly. This results in the value of n greater than 50 to take more time to load “index_path”.

C. <u>Plot two line graphs by reporting the average execution times of knn_grid and knn_linear_scan for the query points generated in (a), against the following value of n: 10, 50, 100, 150, 200. For knn_grid, DO NOT consider the time for loading “index_path” to the main memory.</u>




A. For a given value of k (k=18), knn linear scan would stay constant as it goes through the whole data regardless of the value of n to find the nearest neighbours. However, as n is increased for knn grid, the size of each cell as well as the average number of points inside each cell also decreases. Thus, knn grid has to go through less number of points which satisfies the pruning condition and hence, it takes less time as n increases. Please keep in mind that at a certain big number of n, the cell would start becoming too small and hence, eliminate the advantage talked above, leading to increased time as n increases. For the given graph, the knn grid is at least 30x faster than the knn linear.

D. <u>Plot two line graphs by reporting the average execution times of knn_grid and knn_linear_scan for the query points generated in (a), against the following value of k=1, 2,.., 10. For knn_grid, DO NOT consider the time for loading "index_path" to the main memory.</u>




A. For the given graph, knn grid is at least 600x faster than knn linear. For the fixed value of n to be 50, Knn linear increases linearly as value of k increases. This is because time taken to go through the whole data stays the same however, as more neighbours need to be kept and checked for each new point. Similarly, the knn grid also increases linearly as the value of k increases. This is because higher value of k leads to checking more cells to satisfy this high number of k, leading to increased time taken.

## *Appendix*

*X-value Y-value*

*79.63165936958941 127.98645384595159*
*39.33161639707677 -81.43826531948315*
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*-48.91878356044242 -100.88419470176835*
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*79.66305917456211 126.36942298561621*
*20.158859390496048 82.3389944668179*
*71.71220779431198 -130.067854308954*
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*49.20375053873008 55.43924077051341*
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