

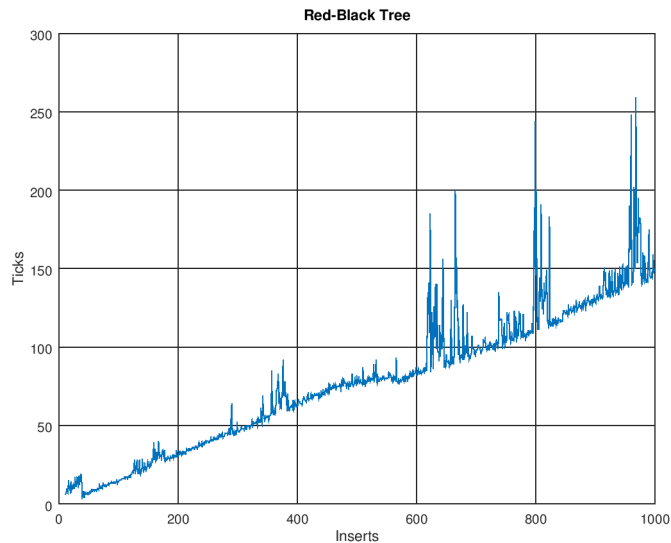
Homework4

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1 Red-Black Tree

The code is in rb-tree/rb-tree.cpp. An insertion takes $O(\lg n)$ time.

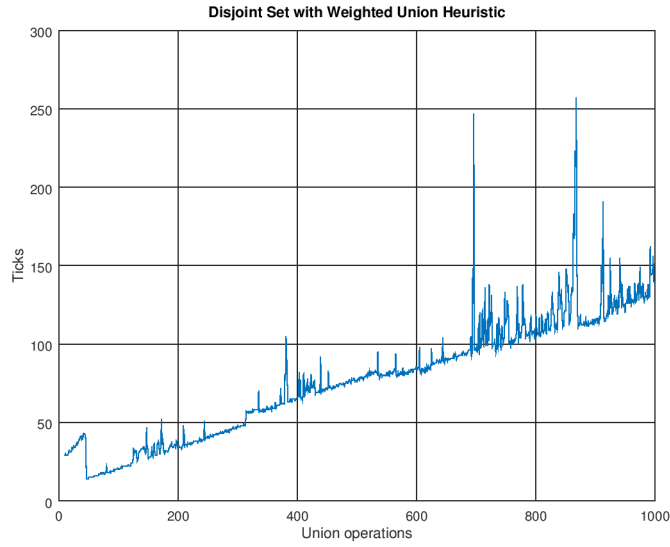


The plot shows the clock ticks it takes to execute n insertions in a Red-Black Tree, which follows a similar curve to $O(\lg n)$.

2 Disjoint Set

2.1 Weighted Union

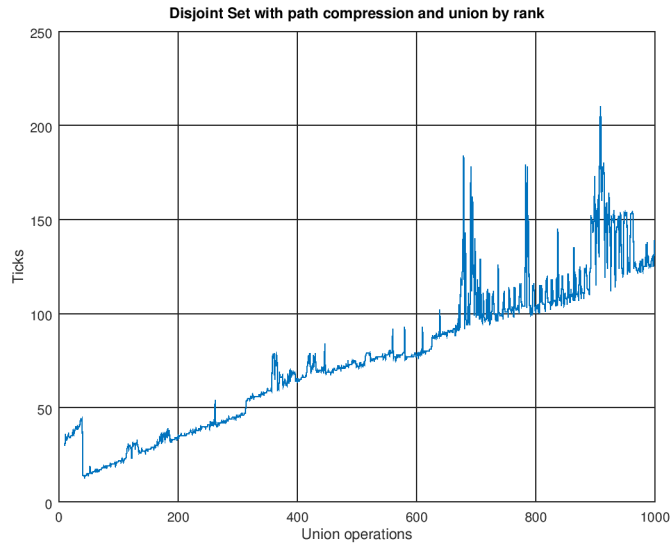
The code is in disjoint-set/linked_disjoint_set.h. Find-Set takes $O(1)$ and Union takes $O(\min|A|, |B|)$. n .



The plot demonstrates that m Union operations with n initial singletons take $O(m + n \lg n)$.

2.2 Union by Rank and Path compression

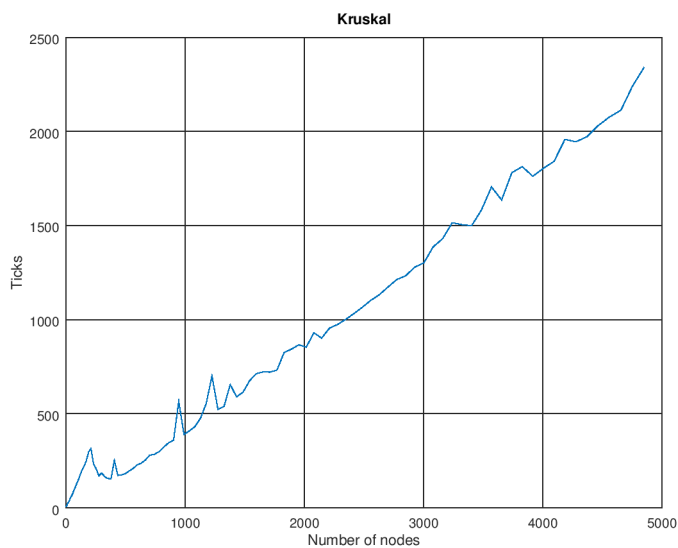
The code is in disjoint-set/disjoint_set.h. Union is supposed $O(1)$ for all practical applications.



As before, the plot shows how m Union operations with n initial singletons take $O(m + n \lg n)$ but this one's time axis reaches a smaller value.

3 Kruskal

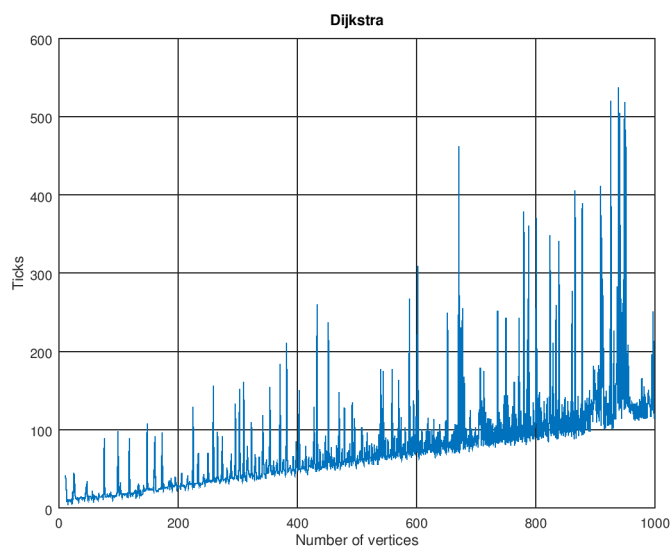
The code is in disjoint-set/kruskal.cpp. The time complexity is $O(ElgV)$.



The plot shows how kruskal applied to a randomly generated graph of E edges and V vertices takes $O(ElgV)$.

4 dijkstra

The code is in dijkstra/dijkstra.cpp. The time complexity is $O(E + VlgV)$.



The plot shows how a dijkstra applied to a randomly generated graph takes $O(E + V \log V)$.