Ryan Garbutt
CS 233
HW4

1)

Mergesort:

In the worst-case scenario, the temporal complexity is O. (n log n).

Because exterior space is necessary, it is an out of place algorithm.

The layout of the input has no bearing on the performance.

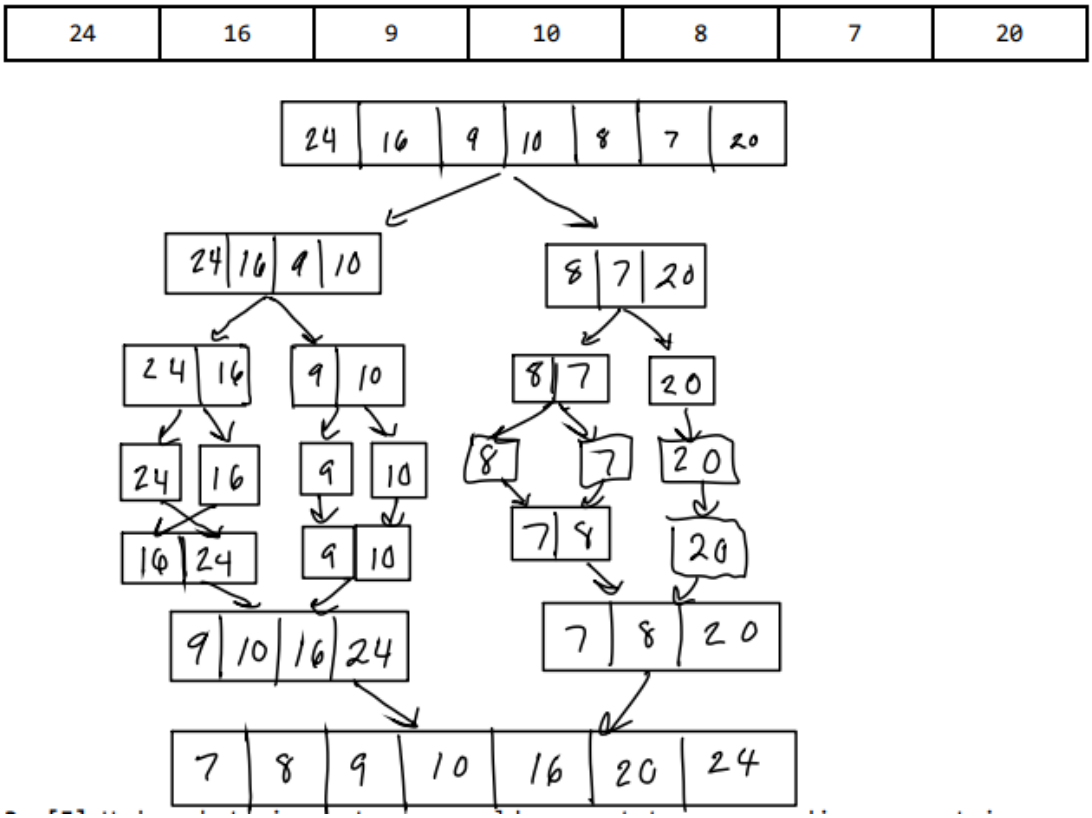
Quicksort:

Time complexity in the worst-case scenario is O. (n).

When the input is sorted, the performance is O in worst-case time complexity (n).

The sequence of the identical input values does not remain the same in the output, making it an unstable algorithm.

2. [10] Draw out how Mergesort would sort this list:



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3)

With adjacency matrices, we may quickly determine whether a certain edge between two vertices belongs to the graph by performing an O(1) lookup. We can also perform rapid edge insertions and deletions. The problem is that we must use a large amount of space (O(n2)), which is inefficient, especially for graphs with numerous vertices, especially if our graph is sparse.

However, it is more difficult to check whether a certain edge is in a graph with adjacency lists, because we must search through the proper list to identify the edge. If we sort them, the time taken can be O(n) or O(log(n)), but they are more space efficient O(E), where E is the number of edges.

4)

Path & Maps, where the goal is to get the quickest route from one location to another, such as in Google Maps, or in some games where the demand is to choose a path from numerous accessible possibilities, are some of the cases where graph is the best data structure to use.

In terms of distance, time, and cost, graphs are perfect for identifying the shortest path among multiple possibilities. Another example is networks, where the best route to transport and pass traffic must be established, and where nodes represent end-systems or other devices like routers, and graph edges represent relationships between these nodes/devices. A matching problem, in which we need to match something to a specific trend, such as matching people to their occupations, uses the bipartite matching principle and then network flow algorithms.

5)

It's aimed at a graph that is cyclic

Because there are arrows connecting one node to the next, it is directed.

6)

v1-v4-v3-v1 is the loop.

Only incoming edges are present in V6 and V7. As a result, these can be ignored.

Only v6 and v7 have edges in v5. Incoming edges are the only ones left. As a result, v5 can be ignored.

If we look at the remaining four edges, we can see that the loop is V1-v4-v3-v1.

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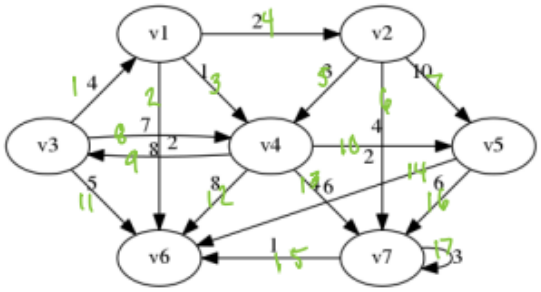
7)

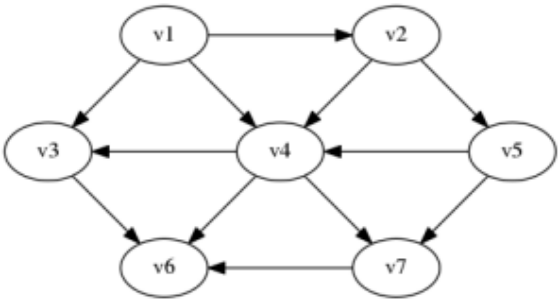


Vertices 7

Edges 17

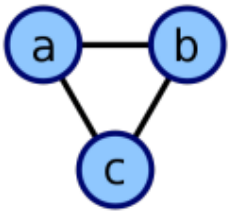
8)

8. [6] Are these cyclic or acyclic graphs?



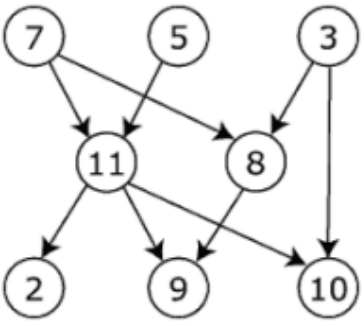
Cyclic?

Yes (No)



Cyclic?

(Yes) No



Cyclic?

Yes (No)

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9)

According to the graph theory of mathematics, a tree is an undirected graph in which any two vertices are connected by exactly one path.

A tree is, in other terms, any acyclic connected graph.

When we look at the above graph as a tree, we can see that it is directed from parent to child because the vertices have a direction between them.

10)

The stack is used for depth first searches, whereas the queue is used for breadth first searches.

A DFS burrows deep through the child node until a target is reached. By finding each solution, a BFS grows each node in a graph.

Before moving on to the next node, the root node performs a breadth first search, which includes all of its near neighbors. Begin a depth first search at a node and traverse as far as feasible, including the branch in front of the originating node, before recursing back to it.

In comparison to time complexity, space complexity in BFS is more challenging, whereas space complexity in DFS is less difficult because it just requires the preservation of a single path, i.e. root to leaf node.

Lastly, when compared to BFS, DFS is faster.

12)

The number of edges that are coming towards a vertex is measured in degrees.

The number of edges that are traveling out of a vertex is called the out degree.

Indegree + Outdegree Equals Degree

To discover answers to the following three questions, examine indegree, outdegree, and degree for each vertex.

1. The most extensive degree

7 = 2(Indegree) + 5(Outdegree) = MAD2104

2. CDA4101 = 3 highest indegree

3. MAD2104 = 5 highest outdegree

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Sorting on a level-by-level basis. Each level's nodes should be evaluated. There is no requirement for a specific order.

Output from the topo sort

MAC3311 COP3210

COP4555 COP3337 COP3400 MAD2104 CAP3700

CDA4400 CDA4101 COP3530 MAD3512 MAD3305

COP4225 COP4610 CIS4610 COP5621 COP4540