Qualifying Exam Advanced Data Structures

1. Provide a formal definition of "Graph" data structure, and describe its differences to "Tree" data structure.

2. Describe the formal definition of "Big-Oh", "Big-Omega", and "Big-Theta" notation.

3. Model the World Wide Web with the "Graph" data structure.

4. Describe the formal definition of "Big-Oh" notation and its strength and weakness compared to real experiments in performance evaluation.

5. Describe the differences between a stack and a queue.

6. Describe the differences between "Binary tree" and "B tree" data structure.

7. Describe the differences between "B+ tree" and "B* tree" data structure.

8. Provide a formal definition of "Max-heap" data structure.

9. Provide a formal definition of "B tree" data structure.

10. Provide a formal definition of "AVL tree" data structure.

11. Provide a formal definition of "M-way tree" data structure.

12. Explain the time complexity of INSERT/SEARCH/DELETE operations on the following data structures: sorted arrays, unsorted arrays, and binary search trees.

13. Provide a formal definition of a Red-Black Tree (RB tree) and discuss the time complexity of INSERT/SEARCH/DELETE operations on a RB tree.

14. Provide a formal definition of a hash function and explain why collisions are inevitable and how to deal with collisions.

15. Provide a formal definition of a universal hash family and explain why it is needed?

16. Provide a pseudo code to find the shortest path between nodes w and all other vertices v in an undirected graph.

17. Explain how to find strongly connected components (SCCs) using the the Depth-First Search (DFS).

18. Describe the differences between Dijkstra's algorithm vs. Bellman-Ford algorithm.

19. Provide a pseudo-code for the QuickSort and explain its (i) expected time complexity and (ii) worst-case time complexity.

End of Questions.