Design and Analysis of Algorithms (DAA-432)

1. **Fundamentals and mathematical background**
   Basic definitions and asymptotic notations (O, o, Ω, ω, Θ), Indicator random variables

2. **Recursion**
   Substitution method, recursive tree method, Master method

3. **Heaps**
   Build heap, heapify, insert node, delete node, change priority

4. **Sorting algorithms**
   Quicksort (best, average, balanced partition, worst), Mergesort (best, average and worst), Heapsort (best, average and worst cases), Bucketsort (best and worst cases), Radixsort (best and worst cases), Lower bound for simple sorting, Linear time sort (counting sort)

5. **Priority queues**
   Complexities

6. **Hashing**
   Hash function, hashing by chaining, Direct Access Table, open hashing

7. **Greedy algorithm**
   Huffman coding, Fractional knapsack, Prims and Kruskal, Dijkstra's shortest path

8. **Randomized algorithm**
   rBST and treaps

9. **Approximate methods**
   Bin-packing problem

10. **Dynamic Programming**
    Matrix chain multiplication, Longest common subsequence, Floyd-Warshall, 0-1 knapsack, Optimal binary search trees

11. **Divide and conquer algorithms**
    Closest pair of points, Convex hull

12. **Backtracking algorithms**
    Depth first search, turnpike reconstruction problem

13. **Branch and bound approach**
    Travelling salesman problem

14. **NP problems**
    Reduction of Hamiltonian path to travelling salesman

15. **Graph algorithms**
    Breadth-first search, strongly connected components, Topological sort, Breadth-first search

16. **Amortized algorithms**
    Splay trees

17. **Trees**
    AVL tree, B/B+-tree, Ternary search trees

18. **Disjoint sets**
    Operations, smart union algorithms, path compression

19. **Median and order statistics**
    kth minimum (quickselect)

20. **String algorithms**
    Rabin-Karp algorithm, Knuth-Morris-Pratt algorithm

List of labs (all on GNU/Linux OS)

1. Elapsed time, gnuplot, graphviz
2. Heapsort vs Mergesort vs QS
3. Priority queues with changeable priority
4. Bucketsort
5. Hashing by chaining (ins, find, del)
6. Huffman coding and decoding
7. Kruskal with sets/Dijkstras
8. rBST/treaps
9. LCS
10. Closest pair of points
11. AVL trees
12. B/B+-trees (ins, find)
13. Ternary search trees (ins, find)
14. Disjoint sets (make, union, find, rep)
15. Rabin-Karp

Suggested books

1. **Introduction to Algorithms** (Ed 2, MIT Press) by *TH Cormen, CE Leiserson, RL Rivest, C Stein*
2. **Data Structures & Algorithms Analysis In C++** (Ed 3, Pearson) by *MA Weiss*
3. **Fundamentals of Algorithmics** (Prentice Hall) by *Gilles Brassard, Paul Bratley*

"You can move the world with an idea, but you have to think of it first." --Anonymous