**Data Structure and Applications**

***Module 1:***

**Introduction:**

Data Structures, Classifications (Primitive & Non Primitive), Data structure Operations, Review of Arrays, Structures, Self-Referential Structures, and Unions. Pointers and Dynamic Memory Allocation Functions. Representation of Linear Arrays in Memory, Dynamically allocated arrays.

**Array Operations:**

Traversing, inserting, deleting, searching, and sorting. Multidimensional Arrays, Polynomials and Sparse Matrices.

**Strings:**

Basic Terminology, Storing, Operations and Pattern Matching algorithms. Programming Examples.

Textbook 1: Chapter 1: 1.2, Chapter 2: 2.2 - 2.7 Text Textbook 2: Chapter 1: 1.1 - 1.4, Chapter 3: 3.1 - 3.3, 3.5, 3.7, Chapter 4: 4.1 - 4.9, 4.14 Reference 3: Chapter 1: 1.4 RBT: L1, L2, L3

Python Programming Examples:

1. <https://github.com/kmgowda/ds-programs-python/blob/master/src/array-rotate.py>
2. <https://github.com/kmgowda/ds-programs-python/blob/master/src/add.py>
3. <https://github.com/kmgowda/ds-programs-python/blob/master/src/bitflips.py>
4. <https://github.com/kmgowda/ds-programs-python/blob/master/src/bit-next.py>
5. <https://github.com/kmgowda/ds-programs-python/blob/master/src/str-len.py>
6. <https://github.com/kmgowda/ds-programs-python/blob/master/src/string-compress.py>
7. <https://github.com/kmgowda/ds-programs-python/blob/master/src/string_anagram_1.py>
8. <https://github.com/kmgowda/ds-programs-python/blob/master/src/substring.py>
9. <https://github.com/kmgowda/ds-programs-python/blob/master/src/substring1.py>
10. <https://github.com/kmgowda/ds-programs-python/blob/master/src/urlify.py>
11. <https://github.com/kmgowda/ds-programs-python/blob/master/src/missing-number.py>
12. <https://github.com/kmgowda/ds-programs-python/blob/master/src/missing-two-numbers.py>
13. <https://github.com/kmgowda/ds-programs-python/blob/master/src/one-edit.py>
14. <https://github.com/kmgowda/ds-programs-python/blob/master/src/subtract.py>
15. <https://github.com/kmgowda/ds-programs-python/blob/master/src/sum-sequence.py>
16. <https://github.com/kmgowda/ds-programs-python/blob/master/src/sum-swap.py>

***Module 2:***

**Stacks:**

Definition, Stack Operations, Array Representation of Stacks, Stacks using Dynamic Arrays, Stack Applications: Polish notation, Infix to postfix conversion, evaluation of postfix expression.

**Recursion -**

Factorial, GCD, Fibonacci Sequence, Tower of Hanoi, Ackerman's function.

**Queues:**

Definition, Array Representation, Queue Operations, Circular Queues, Circular queues using Dynamic arrays, Dequeues, Priority Queues, A Mazing Problem. Multiple Stacks and Queues. Programming Examples.

Textbook 1: Chapter 3: 3.1 -3.7 Textbook 2: Chapter 6: 6.1 -6.3, 6.5, 6.7-6.10, 6.12, 6.13 RBT: L1, L2, L3

Python Programming Examples:

1. <https://github.com/kmgowda/ds-programs-python/blob/master/src/fibnoacci.py>
2. <https://github.com/kmgowda/ds-programs-python/blob/master/src/trailing-zeros-fact.py>
3. <https://github.com/kmgowda/ds-programs-python/blob/master/src/stack-sort.py>
4. <https://github.com/kmgowda/ds-programs-python/blob/master/src/tower.py>
5. <https://github.com/kmgowda/ds-programs-python/blob/master/src/postfix.py>
6. <https://github.com/kmgowda/ds-programs-python/blob/master/src/multiply-rec.py>
7. <https://github.com/kmgowda/ds-programs-python/blob/master/src/string-permutations.py>
8. <https://github.com/kmgowda/ds-programs-python/blob/master/src/string-palindrome-permutation.py>
9. <https://github.com/kmgowda/ds-programs-python/blob/master/src/set-permutations.py>

***Module 3:***

**Linked Lists:**

Definition, Representation of linked lists in Memory, Memory allocation; Garbage Collection. Linked list operations: Traversing, Searching, Insertion, and Deletion. Doubly Linked lists, Circular linked lists, and header linked lists. Linked Stacks and Queues. Applications of Linked lists – Polynomials, Sparse matrix representation. Programming Examples

Textbook 1: Chapter 4: 4.1 – 4.6, 4.8, Textbook 2: Ch apter 5: 5.1 – 5.10, RBT: L1, L2, L3

Python Example programs:

1. <https://github.com/kmgowda/ds-programs-python/blob/master/src/linked-list.py>
2. <https://github.com/kmgowda/ds-programs-python/blob/master/src/list-palindrome.py>
3. <https://github.com/kmgowda/ds-programs-python/blob/master/src/linked-list-dup.py>
4. <https://github.com/kmgowda/ds-programs-python/blob/master/src/number-str.py>
5. <https://github.com/kmgowda/ds-programs-python/blob/master/src/letters-numbers.py>
6. <https://github.com/kmgowda/ds-programs-python/blob/master/src/reverse-list.py>

***Module 4:***

**Trees:**

Terminology, Binary Trees, Properties of Binary trees, Array and linked Representation of Binary Trees, Binary Tree Traversals - Inorder, postorder, preorder; Additional Binary tree operations. Threaded binary trees, Binary Search Trees – Definition, Insertion, Deletion, Traversal, Searching, Application of Trees-Evaluation of Expression, Programming Examples

Textbook 1: Chapter 5: 5.1 –5.5, 5.7; Textbook 2: Chapter 7: 7.1 – 7.9 RBT: L1, L2, L3

Python Programming Examples:

1. <https://github.com/kmgowda/ds-programs-python/blob/master/src/bst-travel-stack.py>
2. <https://github.com/kmgowda/ds-programs-python/blob/master/src/bst-traversal.py>
3. <https://github.com/kmgowda/ds-programs-python/blob/master/src/bst_ancenstor.py>
4. <https://github.com/kmgowda/ds-programs-python/blob/master/src/bst-sucessor.py>
5. <https://github.com/kmgowda/ds-programs-python/blob/master/src/heap-sort.py>
6. <https://github.com/kmgowda/ds-programs-python/blob/master/src/tree-to-list.py>
7. <https://github.com/kmgowda/ds-programs-python/blob/master/src/bst-remove.py>
8. <https://github.com/kmgowda/ds-programs-python/blob/master/src/tree-symmetric.py>
9. <https://github.com/kmgowda/ds-programs-python/blob/master/src/bst-minimalheight.py>
10. <https://github.com/kmgowda/ds-programs-python/blob/master/src/bst-height.py>
11. <https://github.com/kmgowda/ds-programs-python/blob/master/src/bst-balance.py>
12. <https://github.com/kmgowda/ds-programs-python/blob/master/src/bst-level.py>
13. <https://github.com/kmgowda/ds-programs-python/blob/master/src/bst-subarray.py>
14. <https://github.com/kmgowda/ds-programs-python/blob/master/src/avl-tree.py>
15. <https://github.com/kmgowda/ds-programs-python/blob/master/src/avl-tree-height.py>
16. <https://github.com/kmgowda/ds-programs-python/blob/master/src/avl-bfactor.py>
17. <https://github.com/kmgowda/ds-programs-python/blob/master/src/red-black-tree.py>
18. <https://github.com/kmgowda/ds-programs-python/blob/master/src/splay-tree.py>

***Module 5:***

**Graphs:**

Definitions, Terminologies, Matrix and Adjacency List Representation Of Graphs, Elementary Graph operations, Traversal methods: Breadth First Search and Depth First Search.

**Sorting and Searching:**

Insertion Sort, Radix sort, Address Calculation Sort.

**Hashing:**

Hash Table organizations, Hashing Functions, Static and Dynamic Hashing.

**Files and Their Organization:**

Data Hierarchy, File Attributes, Text Files and Binary Files, Basic File Operations, File Organizations and Indexing

Textbook 1: Chapter 6 : 6.1 –6.2, Chapter 7:7.2, Chapter 8 : 8.1-8.3

Textbook 2: Chapter 8 : 8.1 – 8.7, Chapter 9 : 9.1-9.3, 9.7, 9.9

Reference 2: Chapter 16 : 16.1 - 16.7 RBT: L1, L2, L3

Python Programming Examples:

1. <https://github.com/kmgowda/ds-programs-python/blob/master/src/insertion-sort.py>
2. <https://github.com/kmgowda/ds-programs-python/blob/master/src/matrix-rep.py>
3. <https://github.com/kmgowda/ds-programs-python/blob/master/src/max-number.py>
4. <https://github.com/kmgowda/ds-programs-python/blob/master/src/max-matrix.py>
5. <https://github.com/kmgowda/ds-programs-python/blob/master/src/matrix-search.py>
6. <https://github.com/kmgowda/ds-programs-python/blob/master/src/matrix-rotation.py>
7. <https://github.com/kmgowda/ds-programs-python/blob/master/src/matrix-zero.py>
8. <https://github.com/kmgowda/ds-programs-python/blob/master/src/max-matrix.py>
9. <https://github.com/kmgowda/ds-programs-python/blob/master/src/bfs-dfs-graph.py>
10. <https://github.com/kmgowda/ds-programs-python/blob/master/src/directed-graph.py>
11. <https://github.com/kmgowda/ds-programs-python/blob/master/src/all-paths-graph.py>
12. <https://github.com/kmgowda/ds-programs-python/blob/master/src/hash-table.py>

**Textbooks:**

1. Ellis Horowitz and Sartaj Sahni, Fundamentals of Data Structures in C, 2nd Ed, Universities Press, 2014.

2. Seymour Lipschutz, Data Structures Schaum's Outlines, Revised 1st Ed, McGraw Hill, 2014.

**Reference Books:**

1. Gilberg & Forouzan, Data Structures: A Pseudo-code approach with C, 2nd Ed, Cengage Learning,2014.

2. Reema Thareja, Data Structures using C, 3rd Ed, Oxford press, 2012.

3. Jean-Paul Tremblay & Paul G. Sorenson, An Introduction to Data Structures with Applications, 2 nd Ed, McGraw Hill, 2013

4. A M Tenenbaum, Data Structures using C, PHI, 1989

5. Robert Kruse, Data Structures and Program Design in C, 2nd Ed, PHI, 1996.

***Programming Examples Reference Book:***

1. ***Cracking The Coding interview by Gayle Lakman*** 
   1. [***https://github.com/chaudharyachint08/Self-Learning/blob/master/BOOKS/DSA%20%26%20Competitive%20Programming/Cracking-the-Coding-Interview-6th-Edition-189-Programming-Questions-and-Solutions.pdf***](https://github.com/chaudharyachint08/Self-Learning/blob/master/BOOKS/DSA%20%26%20Competitive%20Programming/Cracking-the-Coding-Interview-6th-Edition-189-Programming-Questions-and-Solutions.pdf)
   2. [***https://github.com/chaudharyachint08/Self-Learning/blob/master/BOOKS/DSA%20%26%20Competitive%20Programming/Cracking-the-Coding-Interview-6th-Edition-189-Programming-Questions-and-Solutions.pdf***](https://github.com/chaudharyachint08/Self-Learning/blob/master/BOOKS/DSA%20%26%20Competitive%20Programming/Cracking-the-Coding-Interview-6th-Edition-189-Programming-Questions-and-Solutions.pdf)