GUJARAT TECHNOLOGICAL UNIVERSITY
MASTERS IN COMPUTER APPLICATION
Year – 2 (Semester – III) (W.E.F. JULY 2018)

Subject Name: Basic Mathematics
Subject Code: 4639301_Practical List

List of Computer Lab Exercises (To be implemented in C Language)

Objectives: To get an insight of data structures used in implementation of various basic mathematical concepts and algorithms based on these concepts.

Prerequisites: C Programming Language

Advice (Note) to Teachers:

- The list of exercises given below is an indicative list. It is expected that students will be able to visualize how various mathematical concepts can be used to solve real-life problems through programming.
- Some exercises have been labeled as "Mandatory" while other exercises have been marked as "Desirable". It is expected that all the students will do Mandatory exercises while bright students will additionally do Desirable exercises as well.

List of Computer Lab Exercises

1. Mandatory Exercises: Set Theory and Logic

(a) Start with a NULL set and add elements one-by-one: Use different ways of implementing sets and understand the pros and cons of each of these methods
(b) Given an element value, check whether it is a member of the set or not
(c) Find out the number of elements of a given set.
(d) Complement of a set; Union, Intersection
(e) Test whether a given set X is a subset of the set A or not.
(f) Test whether two given sets are equal or not
(g) Difference and Symmetric Difference of two sets
(h) Write functions for evaluating Logical-And, Logical-Or, Logical-Not, and Logical-XOR of given two Boolean values.

Desirable Exercises: Set Theory & Boolean Logic

(a) Find Cartesian Product of two given sets
(b) Find the Power Set of a given set
(c) Truth table of a Logical expression

2. Mandatory Exercises: Matrices

(a) Write a function to Create a Matrix of size m x n, and another function to Print a Matrix of size m x n.
(b) Print the Transpose of a given matrix A.
(c) Write a program to generate Null matrix of order (m x n) and Unit matrix of order n.
(d) Take as input two matrices, A & B and print A + B and A – B. First check whether it is possible to compute (A + B) and (A – B) or not.
(e) For a given square matrix A, print the Diagonal, Upper Triangular and the Lower Triangular

Matrices of A.
(f) Evaluate Scalar Product of a Matrix A: For example, k A, where k is a constant (number)
(g) Take as input two matrices, A & B and print (A * B) and (B * A). First check which ones out of (A * B) and (A * B) are possible to compute.
(h) Given two matrices, determine whether one matrix is the inverse of the other matrix.

Desirable Exercises – Matrices
(a) For a given matrix A, find its inverse.
(b) Convert a given matrix with many zeros (0's) to Sparse matrix structure and vice versa.
(c) Evaluate the Value of the Determinant of the given Matrix.
(d) Find the Determinant of a square matrix and compute its value. Can it be done recursively?

3. Mandatory Exercises: Integers
(a) Write a program to generate all Prime Numbers between 1 and a given integer N.
(b) Given an integer N, test whether it is a Prime Number or a Composite Number.
(c) Write a program to find Factorial of a given number using (i) an iterative algorithm, and (ii) a recursive algorithm.
(d) Write a program to generate a set of Fibonacci Series up to (less than or equal to) a given number N using (i) an iterative algorithm, and (ii) a recursive algorithm.
(e) Evaluate Prime Factors of a given positive integer. (Assume that an array of prime numbers is available)
(f) Write a program to evaluate GCD (Greatest Common Divisor) of two positive integers using Euclidean algorithm
(g) Write Floor and Ceiling functions.
(h) Evaluate LCM (Least Common Multiple) of two positive integers.
(i) Convert a given Integer in decimal umber system into Binary, Octal, and Hexadecimal number systems.

Desirable Exercises – Integers
(a) Write a program using recursive algorithm to implement Tower of Hanoi problem.
(b) Convert a given Real Number with 3 decimal digits into Binary, Octal, and Hexadecimal.

4. Mandatory Exercises: Binary Relation
(a) Given the Boolean Matrix of a Binary Relation, determine whether the Relation is Reflexive and / or Symmetric.

Desirable Exercises: Binary Relation
(a) For a given Relation, generate a Boolean Matrix. Using Boolean Matrix, determine whether the Relation is Transitive
(b) Find the Partitions of the set using the given equivalence relation defined on the set.

5. Mandatory Exercises: Graphs & Trees
(a) Take inputs of a graph and generate Adjacency Matrix of the graph. Print In-degree, Out-degree, and Total degree of each node.
(b) Represent a given binary tree using linked list structures. Print (i) Number of Leaf nodes, (ii) Intermediate nodes, and (iii) Total number of nodes.
(c) Given a binary tree represented as linked structure, traverse that binary tree using (i) Pre-order (or Depth-first) Traversal, (ii) In-order Traversal, (iii) Post-order Traversal using Recursive Algorithm
(d) Search whether an element is present in a given binary tree or not using Depth-first Search (DFS).

Desirable Exercises: Graphs & Trees

(a) Represent the given Adjacency Matrix of a graph as Sparse Matrix. Print In-degree, Out-degree, and Total degree of each node.

(b) Given a binary tree represented as linked structure, traverse that binary tree using (i) Pre-order Traversal, (ii) In-order Traversal, (iii) Post-order Traversal using Iterative Algorithm

(c) Use Linked List structure to represent threaded binary tree.

(d) Add a new node in a given AVL binary tree.

(e) Delete a specified node from a given AVL binary tree.

(f) Search whether an element is present in a given binary tree or not using Breadth-first Search (BFS).

Reference Books:

1. Kernighan and Ritchie, "C Programming", Pearson Education
2. J. P. Tremblay and W. K. Grassman. "Logic and Discrete Mathematics", Pearson Education,
3. ISRD Group, "Data Structures using C", Tata McGraw Hill, 2006

Reference Websites:

1. www.uva.onlinejudge.org
2. www.cse.iitd.ernet.in/~bagchi/courses/discrete-book/fullbook.pdf

Accomplishment of the student after completing the course:

The student will be able to implement many of the concepts in C language. More specifically, the concept of Sets, Cross Product of Sets, Prime Numbers, Matrices, and basic algorithms related with Binary Tree and Graphs.