ABSTRACT:

This thesis consists of two parts. In part I, a group of combinatorial problems pertaining to strings, boolean matrices and graphs is studied. For given two strings x and y, their edit distance is the minimum number of character insertions, deletions and substitutions required to convert x into y. In this thesis we provide an algorithm that computes a constant approximation of edit distance in truly sub-quadratic time. Based on the provided ideas, we construct a separate sub-quadratic time algorithm that can find an occurrence of a pattern P in a given text T while allowing a few edit errors. Afterwards we study the boolean matrix multiplication (BMM) problem where given two boolean matrices, the aim is to find their product over boolean semi-ring. For this problem, we present two combinatorial models and show in these models BMM requires $\Omega(n^3/2^{O(\sqrt{\log n})})$ and $\Omega(n^{7/3}/2^{O(\sqrt{\log n})})$ work respectively. Furthermore, we also give a construction of a sparse sub-graph that preserves the distance between a designated source and any other vertex as long as the total weight increment of all the edges is bounded by some constant.

In part II, we study the efficient construction of quasi-Gray codes. We give a construction of space optimal quasi-Gray codes over odd sized alphabets with read complexity $4\log_m n$. Moreover, this part also presents a construction of quasi-Gray codes of length $2^n - 20n$ over binary alphabet set with read complexity $6 + \log n$.