INTRODUCTION TO GRAPH ALGORITHMS

PROF. C.PANDU RANGAN
Department of Computer Science and Automation
IISc Bangalore

PRE-REQUISITES : Discrete Mathematics, Graph Theory, Basics of Programming and Data Structures

INTENDED AUDIENCE : UG/PG Students

INDUSTRY SUPPORT : Infosys, TCS, MSR

COURSE OUTLINE :

A Computer is basically an information processing system and this means it can be used for solving only abstract mathematical problems. That is why, solving a Real-World Problem (RWP) by using a computer, begins with a formulation of the RWP as a Mathematical problem in an appropriate mathematical domain. For example, privacy and security problems are formulated as cryptographic problems in Number Theory, Elliptic Curves and Linear Algebra.

Mathematical domains such as combinatorics, Geometry, Sets and Relations, Number Theory, Stringology and Graph Theory are among most frequently used domains to arrive at mathematical problems that are equivalent to the real-world problems.

In this course we focus on basic graph algorithms. Problems arising in communication networks, social networks and transportation networks are naturally modelled as problems on graphs. Graph algorithms are among the extensively investigated and applied topics in computer science.

ABOUT INSTRUCTOR :

Prof. C. Pandu Rangan obtained his doctorate degree from IISc, Bangalore in 1984. His main area of Research is Algorithms. I focus my research in the design of pragmatic algorithms. Problems of practical interest in Graph Theory, Combinatorics and Computational Geometry often turn out to be NP-complete or very hard to solve that we have to look for pragmatic alternatives for them. We explore the avenues such as 1) Restricting the problem domain 2) Approximate algorithm design 3) Randomized Algorithms and 4) Parallel and VLSI Algorithms to arrive at efficient solutions. Our design strategies are neither special purpose (very specific to a problem) nor general purpose (which are too inefficient) but broad purpose ones. Thus, our research efforts can be summarised in a single term - Application Oriented Paradigm Design (AOPD) (one more acronym to the world of Computer Science!). In Cryptology my current focus is on Secure message transmission and Provable security of cryptographic protocols / primitives.

COURSE PLAN :

Week 1: Principles of algorithms

Week 2: Introduction to directed and undirected graphs

Week 3: DAGs and incremental algorithms

Week 4: DFS, BFS of directed and undirected graph

Week 5: Application of DFS – cut vertices/bridges of a graph

Week 6: MST

- Incremental greedy template
- Krushkals algorithms and partition ADT
- PRIMS algorithm and Fibonacci Heaps

Week 7: SSSP

Week 8: APSP