ADVANCED GRAPH THEORY

PROF. RAJIV MISRA
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IIT Patna

TYPE OF COURSE : Rerun | Elective | UG/PG
COURSE DURATION : 8 Weeks (21 Feb' 22 - 15 Apr' 22)
EXAM DATE : 23 Apr 2022

PRE-REQUISITES : Discrete Mathematics

INTENDED AUDIENCE : UG & PG (both)

INDUSTRIES APPLICABLE TO : Companies like Microsoft Research, Google,Facebook, LinkedIn and also start-ups are most eager to apply graph technology.

COURSE OUTLINE :

Advanced Graph Theory focuses on problem solving using the most important notions of graph theory with an in-depth study of concepts on the applications in the field of computer science. This course provides an in-depth understanding of Graphs and fundamental principles and models underlying the theory, algorithms, and proof techniques in the field of Graph Theory. Emerging applications of Graph Theory in Computer Science domain will be covered for significant impact. Upon completing this course, students will have intimate knowledge about how the graph theory play an important role to solve the technology driven and research oriented problems.

ABOUT INSTRUCTOR :

Prof. Rajiv Misra is an Associate Professor in Department of Computer Science and Engineering at Indian Institute of Technology Patna, India. He obtained his Ph.D degree from IIT Kharagpur, M.Tech degree in Computer Science and Engineering from the Indian Institute of Technology (IIT) Bombay, and Bachelors of engineering degree in Computer Science from MNIT Allahabad. His research interests spanned a design of distributed algorithms for Mobile,Adhoc and Sensor Networks, Distributed Cloud Computing and Wireless Networks. He has contributed significantly to these areas and published more than 60 papers in high quality journals and conferences, and 2 book chapters. He has authored papers in IEEE Transactions on Mobile Computing, IEEE Transaction on Parallel and Distributed Systems, Adhoc Networks, Journal of Parallel and Distributed Computing. He is currently editing a book titled as Smart Techniques for a Smarter Planet:Towards Smarter Algorithms for the Studies in Fuzziness and Soft Computing book series,Springer (2017).

COURSE PLAN :

Week 1: Introduction to Graphs & its Applications, Basics of Paths, Cycles, and Trails, Connection, Bipartite Graphs, Eulerian Circuits, Vertex Degrees and Counting, Degree-sum formula, The Chinese Postman Problem and Graphic Sequences.

Week 2: Trees and Distance, Properties of Trees, Spanning Trees and Enumeration, Matrix-tree computation, Cayley's Formula, Prufer code.

Week 3: Matchings and Covers, Hall's Condition, Min-Max Theorem, Independent Sets, Covers and Maximum Bipartite Matching, Augmenting Path Algorithm, Weighted Bipartite Matching, Hungarian Algorithm.

Week 4: Stable Matchings and Faster Bipartite Matching, Factors & Perfect Matching in General Graphs, Matching in General Graphs: Edmonds Blossom Algorithm

Week 5: Connectivity and Paths: Cuts and Connectivity, k-Connected Graphs, Network Flow Ford-Fulkerson Labeling Algorithm, Max-Flow Min-cut Theorem, Menger's Proof using Max-Flow Min-Cut Theorem.

Week 6: Vertex Coloring and Upper Bounds, Brooks Theorem and Color-Critical Graphs, Counting Proper Colorings.

Week 7: Planar Graphs, Characterization of Planar Graphs, Kuratowski's Theorem, Wagner's Theorem.

Week 8: Line Graphs and Edge-coloring, Hamiltonian Graph, Traveling Salesman Problem and NP-Completeness, Dominating Sets.