CE5290 - Transportation Network Analysis

Credit Distribution: C:9 L:3 T:0 P:0 E:0 O:6 TH:0

Course Type: Theory

Description: Network flows: Applications, definitions, graphs, paths, trees, cycles, loops, walk, network representation (adjacency list and matrices) and basic network transformations; Network algorithms; Complexity, Search Algorithms, Strategies for designing polynomial algorithms. Shortest Path Algorithms: Label setting, Dijkstra's and Dial's algorithms, Optimality conditions, label correcting algorithms and optimality conditions, detecting negative cycles, all pair shortest path algorithms; pre-flow push polynomial time algorithms, capacity scaling techniques. Minimum cost network assignment: optimality conditions, cycle canceling algorithm, Successive shortest path algorithm, other polynomial time variants; Network equilibrium analysis; principles and optimization formulations, Frank Wolfe algorithm; Special cases and variants. Applications: Applications of mincost, maxflow, and shortest path algorithms to transportation and infrastructure networks: transportation networks, airline, freight, facility location, logistics, network design, project scheduling, reliability of distribution systems, telecommunication/ power networks etc.

Course Content: Overview, Basic Generic Formulation, Shortest Path, Min. Cost, Max Flow, Examples. Definitions: Graphs (directed, undirected), tails, heads, in degree, out degree, adjacency list, multi arcs, loops, walk, path, cycles (directed, undirected) Representation of Networks: Node-arc incidence matrix, node-node adjacency matrix adjacency list, Basic Network Transformations. Complexity (Big O, o, Omega, omega, THETA, theta), Search Algorithms. Shortest Path Algorithms Label Setting Dijkstra Concept, Optimality, Algorithm, Proof, Complexity Label Correcting Modified Label Correcting, Detecting Negative Cycles, Optimality Conditions. Maximum Flow Problems Assumptions , Definition of cuts, Property 6.1, generic augmenting path, and labeling algorithm ,Theorems 6.3-6.5 Capacity Scaling, Successive Shortest Path. Minimum Cost Problems Optimality, Cycle canceling, Successive Shortest Path Algorithms. Minimum Spanning Tree Algorithms Kruskal's Algorithm, Prim's Algorithm. Traffic Assignment Problem Formulation, Optimality Conditions, Frank-Wolfe Method.

Text Books: NIL

Reference Books: NIL

Prerequisite: NIL