Math 7510: Graph Algorithms

The following topics are representative of those covered in this course.

- Spanning trees:
  Depth-first and breadth-first search spanning trees, minimum-weight spanning trees, Kruskal's and Prim algorithms, the greedy algorithm and relation to matroids

- Shortest paths:
  Algorithms of Dijkstra, Bellman-Ford, Floyd-Warshall

- Matchings:
  Augmenting paths, bipartite matching, the Hungarian method, Edmonds' blossom algorithm, minimum weight perfect matching and Edmonds' matching polyhedron theorem, the Chinese postman problem, T-cuts and T-joins

- Network flows:
  The max-flow min-cut theorem and the associated algorithm, Hoffman's circulation theorem, Hu's 2-commodity flow theorem

- Connectivity:
  Vertex- and edge-disjoint paths in graphs, testing connectivity, decomposing a connected graph into blocks, Tutte's decomposition or a 2-connected graph into cleavage units ("3-connected pieces"), edge-connectivity, Gomory-Hu trees, the two disjoint paths problems

- Coloring:
  Theorems of Brooks and Vizing, edge-coloring bipartite graphs, 5-coloring planar graphs

- Testing planarity:
  Kuratowski's theorem, a planarity testing algorithm that runs in quadratic time or better

- Directed graphs:
  Testing connectivity of digraphs, decomposing a directed graph into strong components, ear decompositions, Roy-Gallai's theorem

- Tree-width
  Basic properties, linear-time algorithms for problems on graphs of bounded tree-width

References:

- Bollobas: *Modern Graph Theory*

- Bondy and Murty: *Graph theory with Applications*

- Cook, Cunningham, Pulleyblank and Schrijver: *Combinatorial Optimization*

- Cormen, Leiserson and Rivest: *Introduction to Algorithms*

- Diestel: *Graph Theory*

- Papadimitriu and Steiglitz: *Combinatorial Optimization*