**CSC373 Study Plan**

**Content**

* Graph Theory
  + Concepts
    - Trees are graphs
    - Subgraphs
    - Spanning Trees
    - Spanning Subgraphs
    - Strongly Connected Components
    - Bipartite Graphs
  + Graph Types
    - Directed/Undirected Graphs
    - Subgraphs
    - Weighted Graphs
  + Graph Representations
    - Edge list
    - Adjacency lists
    - Adjacency matrix
  + Algorithms
    - Breadth First Search
    - Depth First Search
    - Kruskal’s Algorithm
    - Prim’s Algorithm
* Shortest Path Algorithms
  + Concepts
    - Negative-weight cycles imply the “shortest” paths have infinite length – problem is ill-formed
    - Can “re-weight” a graph to eliminate negative edges
  + Single-Source Algorithms
    - Dijkstra’s Algorithm (can only handle positive weights)
    - Bellman-Ford Algorithm (can only handle negative weights, can be modified to detect negative cycles)
  + Multi-Source / All-Pairs Algorithms
    - Bellman-Ford on every vertex (not very efficient)
    - Floyd-Warshall (DP solution)
    - Multiplication of Adjacency Matrices
    - Johnson’s Algorithm (Dijkstra on every vertex of a re-weighted graph)
* Network Flow
  + Concepts
    - Flow Value (total amount of flow in a configuration)
    - Network Flow (flow configuration)
    - Min-Cut Theorem
    - Super-Sources / Super Terminals (can be used to easily solve multi-source/terminal problems)
    - Max-Flow Value of an Integral Network is also Integral
  + Algorithms
    - Ford-Fulkerson
    - Edmond- Karp
  + Applications
    - Maximum Bipartite Matching
* Linear Programming Introduction
  + Concepts
    - Linear Functions
    - Linear Constraints
    - Feasible Solutions
    - Feasible Regions
    - Matrix Representations
    - Polyhedrons
    - Polytopes
    - Vertex Degeneracy
  + Problem Types
    - Infeasible
    - Unbounded
  + Algorithms
    - Interior Points
    - Ellipsoid
    - **Simplex**
* Linear Programming Theory
  + Forms
    - Canonical / Standard Form
    - Slack Form
  + Conversion
    - Minimization / Maximization Conversions
    - Equality/Inequality Conversions
    - Standard/Slack Conversions
  + Duality
    - Duality Theorem
    - Farkas Lemma
    - Weak Duality
    - Strong Duality
* Simplex (in detail)
  + Method
    - High level (traversal along corners)
    - Low level (by hand)
  + Concepts
    - Basic Variable
    - Non-Basic Variable
    - Basic Solution
    - Pivoting
    - Bland’s Rule
    - Cycling
  + Running Time