Post-Midterm Topics

1. Graphs
   - o Graph Representations: adjacency list, adjacency matrix, incidence matrix
   - o Graph Traversal: Breadth-First-Search and Depth-First-Search

     R-13.6, 13.12-13.14 & HW 2
   - o Shortest Path Algorithms: Dijkstra's and Floyd-Warshall Agorithm
     - How do these algorithms differ?
     - Be able to give the node-parent representation of the shortest path tree rooted at a given vertex generated by the algorithm
     - Be able to update the distance and parent arrays as vertices are added to the shortest path tree (SPT)
     - Be able to update the distance and path matrices and do a hand-trace of Floyd-Warshall algorithm.
     - Be able to give the full shortest path pi[x,y], between two vertices generated by the algorithm.
     - Be able to give the shortest distance delta[x,y], between two vertices generated by the algorithm

     R-14.1-14.2 and exercises on the lecture handouts
   - o Topological Ordering: In-degree, Out-degree and Reverse Post-Order Strategies
   - o Be able to give a sequence of vertices showing the ordering using any of these strategies

   R-13.4, 13.10d
   - o Minimum Spanning Tree: Prim's and Kruskal's Algorithms
     - How do these algorithms differ?
     - Be able to do a hand-trace of each algorithm and give the node-parent-weight tabular representation of the MST generated by each algorithm, assuming that vertices of the MST are enumerated in level order.
     - R-15.15 (Repeat using Prim's algorithm)
2. Hashing: Open (closed addressing/separate chaining) and Closed (open addressing) Hasing
   - o In what was do closed and open hashing differ?
   - o Separate Chaining
   - o Open Addressing / Closed Hashing m -> denotes the table size
     - Collision Resolution via Linear Probing (h(k) + i) mod m, i = 1,2,3....
     - Collision Resolution via Quadratic Probing (h(k) + i^2) mod m, i = 1,2,3....
     - Collision Resolution via Double Hashing (h1(k) + ih2(k) mod m, i = 1,2,3....
   - o Birthday Paradox / Probabilities of at least one and no collisions.
   - o Coupon Collector's Problem / Expected number of insertions in an open hash table to fill the table

   R-6.4-6.7, Be able to construct a hash table, tally collisions and compute probabilities relating to collisions. Be able to apply the Coupon Collector's problem to an open hash table.
3. String Matching
   - o Brute-force/Naive String Matcher
     - Be able to do a hand-trace of the algorithm and tally the pairs of elements compared

- Know that its complexity is O(mn), where m is the length of the pattern string and n is the length of the host string.

o Knuth-Morris-Pratt (KMP) String Matcher

- Be able to compute the prefix function, pi, of the pattern string
- Be able to do a hand-trace of the algorithm and tally the pairs of elements compared
- Know that its complexity is O(m + n), where m is the length of the pattern string and n is the length of the host string.

*See exercises on lecture handout

4. B-tree

o What is a b-tree? What are its properties?

o Insertion and the split transformation

o Deletion and the merge transformation

- In-order Successor Replacement Strategy
- In-order Predecessor Replacement Strategy

o Searching a B-Tree

o Traversal (in-order, pre-order and post-order) in a B-tree

o B-tree Arithmetic: min/max height, min/max number of nodes and min/max number of entries in minimal and maximal b-trees wrt size (number of nodes). Know the relevant formulas. Don't need to know how to derive them but must be able to apply them.

o Be able to do a hand-trace of insertion and deletion in a b-tree of any odd degree given a set of entries. Be able to give the node-parent representation of the b-tree as various stages  when these operations are applied to it.

o R-20.4, EX 4.9 from the e-book on Moodle and exercises on the lecture handout

o Be able to give the node-parent representation of a b-tree.

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