CSCE 221 Cover Page

Homework Assignment #3
Due April 25 at 23:59 pm to eCampus

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Please list all sources in the table below including web pages which you used to solve or implement the current homework. If you fail to cite sources you can get a lower number of points or even zero, read more on Aggie Honor System Office website: `http://aggiehonor.tamu.edu/`

Type of sources				
People				
Web pages (provide URL)	Listed Below			
Printed material	Data Structures and Algorithms (Textbook)			
Other Sources				

https://en.wikipedia.org/wiki/Eulerian_path
https://en.wikipedia.org/wiki/Dijkstra%27s_algorithm
https://www.geeksforgeeks.org/greedy-algorithms-set-6-dijkstras-shortest-path-algorithm/
https://en.wikipedia.org/wiki/Double_hashing

I certify that I have listed all the sources that I used to develop the solutions/codes to the submitted work.
On my honor as an Aggie, I have neither given nor received any unauthorized help on this academic work.

Your Name Hunter Cleary Date 4/24/18

Homework 3 (100 points)

due April 25 at 11:59 pm to eCampus.

Write clearly and give full explanations to solutions for all the problems. Show all steps of your work.

Reading assignment.

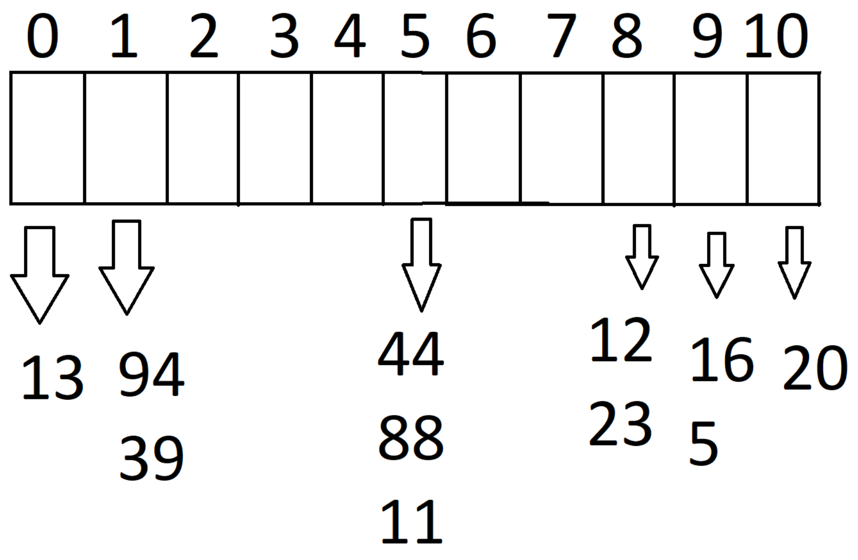
- Hash Tables Chap. 9
- Heap and Priority Queue, Chap. 8
- Graphs, Chap. 13

Problems.

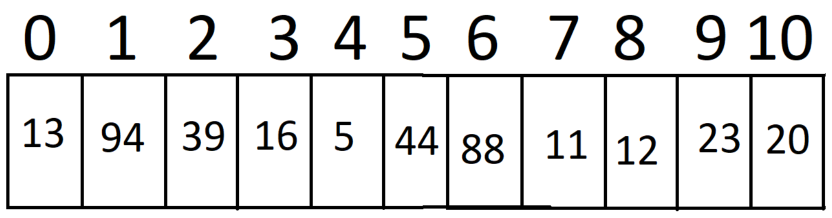
1. (10 points) R-9.7 p. 417

   Draw the 11-entry hash table that results from using the has function, $h(k) = (3k + 5) \bmod 11$, to hash the keys 12, 44, 13, 88, 23, 94, 11, 39, 20, 16, and 5, assuming collisions are handled by chaining.

   $h(k) = (3k + 5)\%11$
   $h(12) = 8,\ h(44) = 5,\ h(13) = 0,\ h(88) = 5,\ h(23) = 8,\ h(94) = 1,\ h(11) = 5,\ h(39) = 1,\ h(20) = 10,\ h(16) = 9,\ h(5) = 9$



2. (10 points) R-9.8 p. 417 What is the result of the previous exercise, assuming collisions are handled by linear probing?



0	1	2	3	4	5	6	7	8	9	10
13	94	39	16	5	44	88	11	12	23	20

3. (10 points) R-9.10 p. 417

What is the result of Exercise R-9.7, when collisions are handled by double hashing using the secondary hash function $h_s(k) = 7 - (k \bmod 7)$?

0	1	2	3	4	5	6	7	8	9	10
13	94	23	88	11	44	39	5	12	16	20

4. (10 points) R-8.7 p. 361

An airport is developing a computer simulation of air-traffic control that handles events such as landings and takeoffs. Each event has a *time-stamp* that denotes the time when the event occurs. The simulation program needs to efficiently perform the following two fundamental operations:

- Insert an event with a given time-stamp (that is, add a future event)
- Extract the event with smallest time-stamp (that is, determine the next event to process)

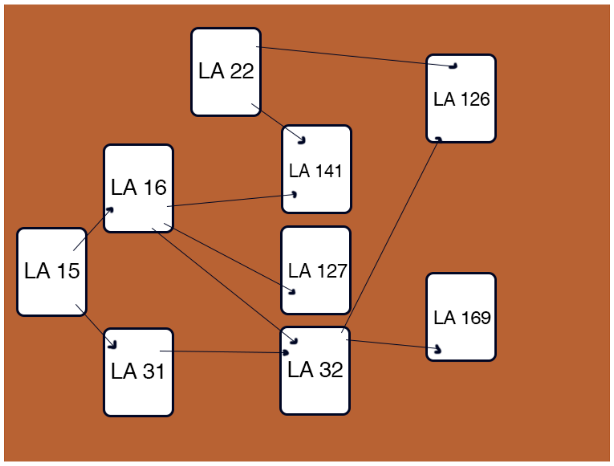
Which data structure should be used for the above operations? Why? Provide big-oh asymptotic notation for each operation.

Solution

The data structure that should be used for this scenario is a binary heap. The heap is made up of nodes that have a key and an element. These will correspond to the time and the event.

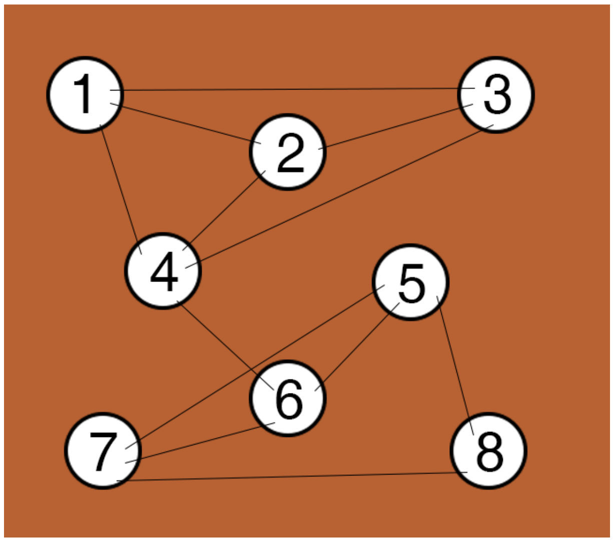
Insertion and search for the binary heap wold both be done in $O(logn)$ time.

5. (10 points) R-13.5, p. 654



$LA15- > LA16- > LA31- > LA22- > LA141- > LA127- > LA32- > LA169- > LA126$

6. (10 points) R-13.7, p. 655



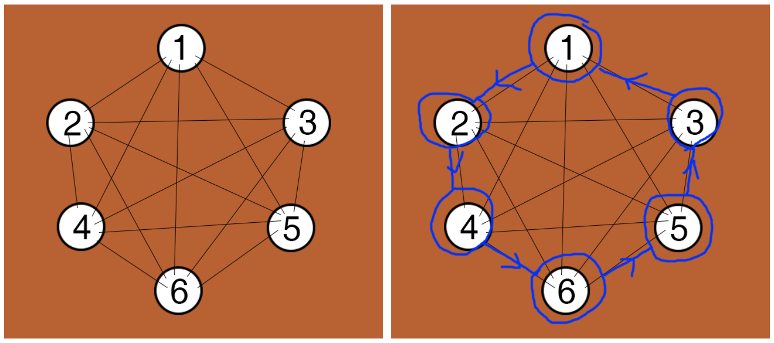
DFS Traversal: 1 -> 2 -> 3 -> 4 -> 6 -> 5 -> 7 -> 8
BFS Traversal: 1 -> 2 -> 3 -> 4 -> 6 -> 5 -> 7 -> 8

7. (10 points) R-13.16, p. 656
Initialize $D[v] = 0$ and $D[u] = \infty$ for every vertex that isn't the root.

Priority queue contains all vertices of the graph G using keys as labels for D.

For each vertex u, there is a closest u. Whenever a vertex u that isn't the root is removed from the priority queue add an edge (closest to u, u) to the tree.

8. (10 points) R-13.31, p. 657



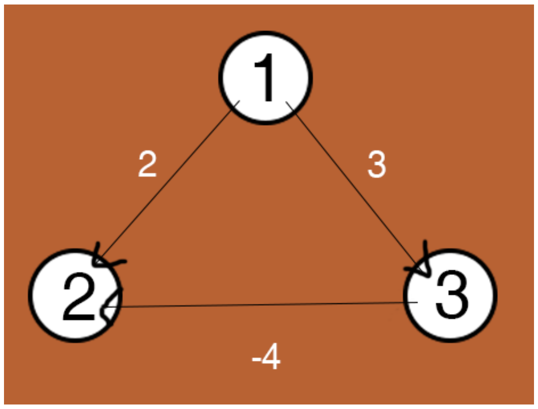
DFS Yields: 1 -> 2 -> 4 -> 6 -> 5 -> 3

9. (10 points) C-13.10, p. 658

   Set a starting vertex v. Find a cycle starting and ending at the starting vertex v so that it contains all edges going into and out of v. Put each edge of the cycle into a list in the order of the cycle. Traverse the list to find the first vertex that has an outgoing edge that is un-visited. If the vertex doesn't have the outgoing edge, then the algorithm is complete. If not, then recursively repeat function with the new edge to create a new cycle.

   The algorithm visits and puts into a list each edge in $O(1)$ time. The total time complexity is then $O(m + n)$. m is the number of edges, and n is the number of vertices in the graph.

10. (10 points) C-13.15, p. 659



   The algorithm will start on vertex 1. Edges 1 -> 2 and 1 -> 3 will be relaxed first (order is not consequential). These two will be pulled off of the priority queue. Dijkstra's algorithm will determine 2's shortest path to be 1 -> 2, when it is actually 1 -> 3 -> 2.