COMP 160 Overview Part I: Chart of Problems & Algorithms

For Homework 13 credit, fill in all underlined cells and answer the "Other Questions". Submissions on Gradescope may be either typewritten or handwritten.

Problem	Input	Output	Algorithm	Runtime	Other Questions
Sorting	Unsorted Array	Sorted Array	Insertion Sort	$O(n^2)$	-
			Bubble Sort	$O(n^2)$	-
			Mergesort	$O(n \log n)$	$T(n) = 2T(\frac{n}{2}) + \Theta(n)$
			Quicksort	$O(n \log n)$	Worst = $O(n^2)$, Expected = $O(n \log n)$
			Heapsort	$O(n \log n)$	Can find k-largest/smallest elements easil
Find Minimum	Unsorted Array	Minimum Value	-	$O(n)$	-
	Min-heap			$O(1)$	-
	Max-heap			$O(n)$	-
	BST			$O(n)$	-
	RB Tree			$O(\log n)$	-
Find kth Smallest	Unsorted Array	Element	Select	$O(n)$	Worst = $O(n^2)$
			Randomized Selection	$O(n)$	Exepcted = $O(n)$, Worst = $O(n^2)$
	Min-heap		-	$O(k \log n)$	
	BST			$O(n)$	n=number of nodes
	RB Tree			$O(\log n)$	-
	RB Tree Augmentd with rank of each node			$O(h)$	h=height of tree
Find rank of element	Unsorted Array	Integer between 1 and n	keep track of all elements smaller than x	$O(n)$	-
	Min-heap		-	$O(r)$	r= rank
	BST			$O(n)$	-

Problem	Input	Output	Algorithm	Runtime	Other Questions
	RB Tree			$O(\log n)$	-
	RB Tree Augmented with ranks			$O(\log r)$	r=rank
Sorting Cont'd	Unsorted array of integers in range $\{1 \dots k\}$	Sorted Array	Counting Sort	$O(n+k)$	-
	Unsorted array of integers of length l using d digits		Radix Sort	$O(l(n+d))$	-
Enumerate how many numbers are in a given interval	Interval and list of numbers	Integer	Range-Counting	$O(n)$	-
MST	A tree	Tree	Kruskal	$O(E \log V)$	-
	A tree		Prim	$O(E \log V)$	-
SSSP	Unweighted graph + source s	Tree	BFS	$O(V+E)$	
	Weighted graph + source s	Tree and True/False	Bellman Ford	$O(VE)$	
	Weighted graph + source s	Tree	Dijkstra's	$O(E \log V)$	-
Finding cut-vertices	A tree	List of verticies	CV from handout	$O(m)$	-

Data Structures Comparsion - Fill out entire table with runtimes

	Insert	**Delete (pointer known)**	**Search**	**Preprocessing (Build structure from unsorted array)**
Unsorted array	$O(1)$	$O(n)$	$O(n)$	$O(1)$
Sorted array	$O(n)$	$O(n)$	$O(\log\ n)$	$O(n\ \log n)$
BST	$O(n)$	$O(n)$	$O(n)$	$O(n)$
RB Tree	$O(\log\ n)$	$O(\log\ n)$	$O(\log\ n)$	$O(n\ \log\ n)$
Hash table w/ chaining, array size m	$O(1+\frac{n}{m})$	$O(1+\frac{n}{m})$	$O(1+\frac{n}{m})$	$O(m)$
Hash table w/ uniform open addressing, array size m	$O(\frac{1}{1-\frac{n}{m}})$	$O(\frac{1}{1-\frac{n}{m}})$	$O(\frac{1}{1-\frac{n}{m}})$	$O(m)$