

## COMP 160 Overview Part I: Chart of Problems & Algorithms

Homework 11 is graded on effort. For full credit fill in all underlined cells and answer the “Other Questions” (Homework 10, Part 2). For this exercise we accept both handwritten or typed answers.

Problem	Input	Output	Algorithm	Runtime	Other Questions
Sorting	Unsorted Array	Sorted Array	Insertion Sort	$\theta(n^2)$	-
			Bubble Sort	$\theta(n^2)$	-
			Mergesort	$\theta(n \log n)$	$T(n) = 2T(n/2) + \theta(n)$
			Quicksort	$\theta(n \log n)$	Expect runtime: $\theta(n \log n)$ , Worst runtime: $\theta(n^2)$
			Heapsort	$\theta(n \log n)$	It is in-place (no extra memory needed)
Find Minimum	Unsorted Array	Minimum Value	-	$\theta(n)$	-
	Min-heap			$\theta(1)$	-
	Max-heap			$\theta(n)$	-
	BST			$\theta(\text{height})$	worst case: $\theta(n)$
	AVL Tree			$\theta(\log n)$	-
Find $k$ th Smallest	Unsorted Array	Element	Select	$\theta(n)$	worst case: $\theta(n)$
			Randomized Selection	$\theta(n^2)$	expected runtime: $\theta(n)$ worst case runtime: $\theta(n^2)$
	Min-heap		-	$\theta(k \log n)$	
	BST			$\theta(h + k)$	-
	AVL Tree			$\theta(h + k)$	-
	AVL Tree Augmented with number of nodes in left subtree			$\theta(\log n)$	-

Problem	Input	Output	Algorithm	Runtime	Other Questions
Find rank of element	Unsorted Array	Integer between 1 and $n$	Count the number of elements less than target element in the array	$\theta(n)$	-
	Min-heap		-	$\theta(n)$	-
	BST			$\theta(n)$	-
	AVL Tree			$\theta(n)$	-
	AVL Tree Augmented with number of nodes in left subtree			$\theta(1)$	-
Sorting Cont'd	Unsorted array of integers in range $\{1 \dots k\}$	Sorted Array	Counting sort	$\underline{n+k}$	-
	Unsorted array of integers of length $l$ using $d$ digits		Radix sort	$l(n+d)$	-
Enumerate how many numbers are in a given interval	<u>answer28</u>	Integer	Range-Counting	<u>answer29</u>	-
MST	Undirected graph	Tree	Prim's Algorithm	$\theta(n + m \log n)$	-
	Undirected graph		Kruskal's Algorithm	$\theta(n + m)$	-
SSSP	Unweighted graph + source $s$	Tree	BFS	$\theta(m \log m + n)$	
	Weighted graph + source $s$	Tree	Bellman-Ford	$\theta(mn)$	
	Weighted graph + source $s$	Tree and True/False	Dijkstra	$\theta(m \log m + n)$	-
Finding cut-vertices	A graph	cut edges	Hopcroft-Tarjan's algorithm	$\theta(m + n)$	-

Data Structures Comparision - Fill out entire table with runtimes

	Insert	Delete (pointer known)	Search	Preprocessing (Build structure from unsorted array)
Unsorted array	$\theta(1)$	$\theta(n)$	$\theta(n)$	$\theta(1)$
Sorted array	$\theta(n)$	$\theta(n)$	$\theta(\log n)$	$\theta(n \log n)$
BST	$\theta(\text{height})$	$\theta(\text{height})$	$\theta(\text{height})$	$\theta(n \log n)$
AVL Tree	$\theta(\log n)$	$\theta(\log n)$	$\theta(\log n)$	$\theta(n \log n)$
Hash table w/ chaining, array size m	$\theta(1)$	$\theta(1 + \alpha)$	$\theta(1 + \alpha)$	$\theta(n)$
Hash table w/ uniform open addressing, array size m	$\theta((1 - \alpha)^{-1})$	$\theta((1 - \alpha)^{-1})$	$\theta((1 - \alpha)^{-1})$	$\theta(n)$