Quiz 4 Practice Questions

Quiz 4 Problems

Quicksort and Randomized Quicksort

- Describe how Quicksort partitions an array. What happens during each recursive step?

- For the input array $[6, 5, 4, 1, 2, 3]$, trace the calls made by Quicksort when the last element is always chosen as pivot. Write the contents of the array after each step.

- What is the best-case scenario for Quicksort, and what input pattern produces it?

- What is the worst-case scenario for Quicksort, and what input pattern produces it?

- Write the recurrence for Quicksort's runtime in the best-case (perfectly balanced splits) and solve it using the Master Theorem.

- Write the recurrence for Quicksort's runtime in the worst-case (one element per partition) and solve it.

Convex Hull

- Define the Convex Hull problem by stating what the input and output should represent.

- Describe the brute-force approach to computing the convex hull of a set of 2D points. What is its runtime and why?

- Describe the high-level idea behind the QuickHull algorithm.

- What is the worst-case time complexity of QuickHull? Draw a point configuration where it occurs.

- Describe the recursive structure of QuickHull and write its recurrence when splits are even.

Writing and Solving Recurrences

- Write a recurrence relation for the following pseudocode:

```
def mystery(n):
    if n <= 1:
```

```
        return  1
    return  3  *  mystery (n//2)  +  n
```

- Solve the recurrence from the previous problem using the Master Theorem.

- Use the recursion tree method to solve: $T(n) = T(n/3) + n$

- Solve $T(n) = 2T(n/2) + n$ using the Master Theorem.

- Solve $T(n) = T(n-1) + n$ using the recursion tree method.

- Given a recurrence $T(n) = 4T(n/2) + n^2$, classify the function using the Master Theorem.