LeetCode Problems

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This is a collection of my notes on particularly difficult problems, and how I arrived at the solution.

Median of Two Sorted Arrays

Given two sorted arrays x and y of size m and n respectively, return the median of the two sorted arrays.

Solution

The sorted arrays are given by $x = [x_0, x_1, \cdots, x_{m-1}]$ and $y = [y_0, y_1, \cdots, y_{n-1}]$.

We can restate the problem: given two arrays x and y of size m and n respectively, find a partition of x, $x = [x^1 \ x^2]$, and a partition of y, $y = [y^1 \ y^2]$, such that $[x^1 \ y^2]$ is a sorted array and $[y^1 \ x^2]$ is also a sorted array. x^1, y^1, x^2, and y^2 can potentially be empty.

Since x and y are sorted arrays, the medians of the respective arrays are found in the middle. Let $i_1 = \lfloor \frac{m-1}{2} \rfloor$ be the index of the median for x (or the lower median if x is even), and let $j_1 = \lfloor \frac{n-1}{2} \rfloor$ be the index of the median for y (or the lower median likewise).

Without loss of generality, let $x_{i_1} \leq y_{j_1}$. Relabel if necessary.

Using binary search, we find the index where y_{j_1} partitions x into two halves. Find the index of the smallest element of the "larger half" of x (in that the elements in it are greater than the elements in the lower half) partitioned by y_{j_1} and label it i_2, i.e. $x_{i_2} \geq y_{j_1}$ and $x_{i_2} \leq x_k \quad \forall x_k \geq y_{j_1}$.

Likewise, find the index of the largest element of the "smaller half" of y partitioned by x_{i_1} and label it j_2, i.e. $y_{j_2} \leq x_{i_1}$ and $y_{j_2} \geq y_k \quad \forall y_k \leq x_{i_1}$.

We note several things. Since $x_{i_1} \leq y_{j_1}$, $y_{j_2} \leq x_{i_1} \leq y_{j_1}$. Thus, $y_{j_2} \leq y_{j_1}$. Furthermore, $x_{i_2} \geq x_{j_1}$, and so $y_{j_2} \leq y_{j_1} \leq x_{i_2}$. Thus $y_{j_2} \leq x_{i_2}$

This conclusion is critical