Problem of the Week – Minimum Radio Broadcast Range

Company: Spotify
Difficulty: Medium
Topic: Greedy, Binary Search, Arrays

Scenario

You are the **technical director of WSPT Radio**, responsible for ensuring nationwide listeners can tune in to broadcasts.

Listeners live along a **1D horizontal line** ranging from `0` (west) to `1000` (east).
Several radio towers are already installed at different positions.

To save energy and cost, you want to determine the **minimum range** each tower must broadcast so that **every listener** is covered by at least one tower.

Problem Statement

Given:

- A list of `N` listeners' positions.
- A list of `M` radio towers' positions.

Find the **minimum broadcast range R** such that **every listener is within range of at least one tower**.

Input Format

- First line: integer `N` – number of listeners.
- Second line: `N` space-separated integers – positions of listeners.
- Third line: integer `M` – number of towers.
- Fourth line: `M` space-separated integers – positions of towers.

Output Format

- A single integer – the **minimum broadcast range** required.

Constraints

- `1 ≤ N, M ≤ 10^5`
- `0 ≤ position ≤ 1000`

Examples

Sample Input 0

```
4
1 5 11 20
3
4 8 15
```

Sample Output 0

```
5
```

Explanation 0

- Listener `1` → covered by tower `4` (distance 3)
- Listener `5` → covered by tower `4` or `8` (distance 1–3)
- Listener `11` → covered by tower `8` or `15` (distance 3–4)
- Listener `20` → covered by tower `15` (distance 5)

So the **minimum required broadcast range = 5**.

Approaches

1. **Brute Force (O(N × M))**
   - For each listener, compute distance to all towers.
   - Take the minimum distance for each listener, and the maximum among those.
   - Works but too slow for large inputs.
2. **Efficient Binary Search (O(N log M))**
   - Sort tower positions.
   - For each listener, use **binary search** to find the closest tower.
   - Track the max of these minimum distances.
3. **Two-Pointer Greedy Approach (O(N + M))**
   - Sort both listeners and towers.
   - Sweep line with two pointers to always find nearest tower for each listener.
   - Keep maximum of minimum distances.

Practice Links

- LeetCode 475 – Heaters (Similar Problem)
- GeeksforGeeks – Find minimum radius of heaters to cover all houses