

First Bad Version

Leetcode Solution

First Bad Version LeetCode

Solution: A Comprehensive Guide

Every now and then, a topic captures people's attention in unexpected ways, and the "First Bad Version" problem on LeetCode is one of those intriguing challenges that programmers often encounter. This problem not only tests a developer's ability to implement an efficient algorithm but also emphasizes the importance of binary search in real-world debugging scenarios.

What is the First Bad Version Problem?

The problem states that you are given n versions, from 1 to n , and you want to find out the first bad one, which causes all the following versions to be bad. You are provided an API `bool isBadVersion(version)` which returns whether a version is bad. Your task is to implement a function that returns the earliest version that is bad.

At first glance, this might seem straightforward, but the challenge lies in minimizing the number of calls to the API, as

calling it excessively can be inefficient, especially when n is very large.

How to Approach the Problem Efficiently

Naively, one could check every version from 1 to n , but this linear search approach results in $O(n)$ time complexity, which is impractical for large n . Instead, a binary search method is preferred as it significantly reduces the required calls to the API.

Binary Search Solution Explained

Binary search works by dividing the range of versions into halves and determining which half contains the first bad version:

1. Initialize two pointers: $left = 1$, $right = n$.
2. While $left < right$, calculate the mid-point: $mid = left + (right - left) / 2$.
3. Call `isBadVersion(mid)`:
 1. If true, it means the first bad version is at mid or before, so set $right = mid$.
 2. If false, it means the first bad version is after mid , so set $left = mid + 1$.
4. When $left == right$, that position is the first bad version.

This approach ensures an $O(\log n)$ time complexity, as the search space is halved each iteration.

Sample Code in Python

```
def firstBadVersion(n):
    left, right = 1, n
    while left < right:
        mid = left + (right - left) // 2
        if isBadVersion(mid):
            right = mid
        else:
            left = mid + 1
    return left
```

Here, `isBadVersion` is an API you call to check the status of a version.

Real-World Applications

The logic behind the "First Bad Version" problem is applicable in software testing and deployment pipelines. When a bug is introduced in a sequence of versions, this algorithm can help quickly identify the faulty version, saving time in debugging and fix deployment.

Tips and Common Pitfalls

1. Carefully handle the mid calculation to avoid integer overflow (use `mid = left + (right - left) // 2` instead of `(left + right) // 2`).
2. Make sure to update pointers correctly to avoid infinite loops.
3. Test edge cases such as when the first version is bad or

when no versions are bad.

Conclusion

The "First Bad Version" problem is a classic example that highlights the power of binary search in optimizing search algorithms. By mastering this approach, developers can improve their problem-solving skills and write more efficient code for real-world scenarios.

Mastering the First Bad Version LeetCode Solution: A Comprehensive Guide

In the world of coding interviews, LeetCode problems are often the litmus test for a developer's problem-solving skills. Among these, the 'First Bad Version' problem stands out as a classic example of a binary search problem. This guide will walk you through the intricacies of solving this problem, providing you with a clear understanding and practical solutions.

Understanding the Problem

The 'First Bad Version' problem presents you with an array of versions of a product, where each version is either good or bad. The challenge is to find the first bad version in the array. The array is sorted in ascending order, and you are given a function `isBadVersion(version)` that returns true if the

version is bad and false otherwise.

Approach to the Solution

To solve this problem efficiently, you need to use a binary search algorithm. Binary search is a divide-and-conquer algorithm that works by repeatedly dividing the search interval in half. If the value of the search key is less than the item in the middle of the interval, narrow the interval to the lower half. Otherwise, narrow it to the upper half. Repeatedly check until the value is found or the interval is empty.

Step-by-Step Solution

1. ****Initialize Pointers****: Start with two pointers, ``left`` and ``right``, set to the start and end of the array, respectively.
2. ****Binary Search Loop****: While ``left`` is less than or equal to ``right``, calculate the middle index ``mid`` as the average of ``left`` and ``right``.
3. ****Check Middle Version****: Use the ``isBadVersion`` function to check if the middle version is bad.
4. ****Adjust Pointers****: If the middle version is bad, set ``right`` to ``mid - 1`` to search the left half. If it is good, set ``left`` to ``mid + 1`` to search the right half.
5. ****Return Result****: Once the loop ends, ``left`` will point to the first bad version.

Code Implementation

Here is a sample implementation in Python:

```
def firstBadVersion(n):  
    left, right = 1, n  
    while left < right:  
        mid = left + (right - left) // 2  
        if isBadVersion(mid):  
            right = mid  
        else:  
            left = mid + 1  
    return left
```

Time and Space Complexity

The time complexity of this solution is $O(\log n)$, as we are halving the search space in each iteration. The space complexity is $O(1)$, as we are using a constant amount of extra space.

Practical Applications

Understanding and solving the 'First Bad Version' problem is not just about acing coding interviews. It helps you grasp the concept of binary search, which is widely used in various real-world applications, such as search engines, databases, and more.

Conclusion

Mastering the 'First Bad Version' problem is a crucial step in your journey to becoming a proficient problem solver. By understanding the problem, applying the binary search algorithm, and practicing the solution, you can tackle similar problems with confidence.

Investigative Analysis of the "First Bad Version" LeetCode Solution

In the realm of software development and algorithmic challenges, the "First Bad Version" problem stands as a critical touchstone for understanding efficient search techniques. At its core, this problem encapsulates the necessity of rapid diagnosis in iterative systems – a vital function in continuous integration and deployment workflows.

Context and Origins

The "First Bad Version" problem emerges from a common scenario in software version control and testing. Suppose a sequence of software builds or versions is released, with some versions being stable while others contain a defect. Identifying the initial faulty version quickly is essential to mitigating risks and ensuring software reliability.

Algorithmic Foundation

The problem is typically presented as follows: among n versions, all versions after a certain point are defective (bad). The goal is to identify the earliest such version. While a brute-force approach would sequentially check each version, this linear method is inefficient, especially for large n .

Binary search offers a powerful alternative by exploiting the ordered nature of the problem. By iteratively halving the search space based on the outcome of the `isBadVersion` API, the algorithm achieves logarithmic time complexity, massively optimizing performance.

Implementation Challenges

Implementing the binary search requires careful attention to boundary conditions. A common pitfall involves incorrectly updating the search pointers, which can lead to infinite loops or off-by-one errors. Moreover, considerations such as integer overflow during midpoint calculation necessitate adopting safe arithmetic operations.

Broader Implications

Beyond the confines of LeetCode, this problem reflects real-world debugging and fault isolation scenarios. The strategy exemplifies how algorithmic thinking can streamline the identification of root causes in complex systems. It underscores the importance of minimizing costly operations—in this case, the calls to an expensive API or test

suite.

Consequences and Lessons Learned

Mastering this problem equips developers with a nuanced understanding of binary search and its practical applications. It illustrates how abstract algorithmic patterns inform everyday programming tasks and decision-making processes in software maintenance. Furthermore, the problem encourages a mindset of efficiency and precision, qualities indispensable in professional software engineering.

Conclusion

The "First Bad Version" problem is more than a coding challenge; it is a microcosm of real-world software development challenges. Its study reveals deep insights into algorithmic efficiency, problem-solving under constraints, and the critical role of strategic testing. As software systems grow ever more complex, such foundational problems will remain central to ensuring quality and reliability.

The First Bad Version LeetCode Solution: An In-Depth Analysis

The 'First Bad Version' problem on LeetCode is a classic example of a binary search problem. It challenges developers to find the first occurrence of a bad version in a sorted array of versions. This article delves into the problem's intricacies, exploring the underlying algorithms, optimizations, and

practical applications.

The Problem Statement

The problem presents an array of versions, each of which is either good or bad. The array is sorted in ascending order, and the task is to find the first bad version. The only function provided is `isBadVersion(version)`, which returns true if the version is bad and false otherwise.

Binary Search: The Core Algorithm

Binary search is the algorithm of choice for solving this problem. It works by repeatedly dividing the search interval in half. If the value of the search key is less than the item in the middle of the interval, narrow the interval to the lower half. Otherwise, narrow it to the upper half. This process continues until the value is found or the interval is empty.

Optimizing the Binary Search

The key to optimizing the binary search in this problem lies in how you adjust the pointers. When you find a bad version, you need to search the left half to find the first occurrence. Conversely, if the middle version is good, you search the right half.

Code Implementation and Analysis

Here is a sample implementation in Python, followed by an analysis of its time and space complexity:

```
def firstBadVersion(n):  
    left, right = 1, n  
    while left < right:  
        mid = left + (right - left) // 2  
        if isBadVersion(mid):  
            right = mid  
        else:  
            left = mid + 1  
    return left
```

The time complexity of this solution is $O(\log n)$, as we are halving the search space in each iteration. The space complexity is $O(1)$, as we are using a constant amount of extra space.

Practical Applications and Real-World Use Cases

Understanding and solving the 'First Bad Version' problem is not just about acing coding interviews. It helps you grasp the concept of binary search, which is widely used in various real-world applications, such as search engines, databases, and more.

Conclusion

Mastering the 'First Bad Version' problem is a crucial step in your journey to becoming a proficient problem solver. By understanding the problem, applying the binary search algorithm, and practicing the solution, you can tackle similar problems with confidence.

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Questions & Answers About first bad version leetcode solution

No	Question	Answer
1	What is the main goal of the First Bad Version problem on LeetCode?	The main goal is to find the earliest version in a sequence of versions that is identified as bad, using the provided isBadVersion API.
2	Why is binary search preferred over a linear search in solving the First Bad Version problem?	Binary search is preferred because it reduces the number of calls to the isBadVersion API from $O(n)$ to $O(\log n)$, making the solution more efficient for large inputs.

3	How does the binary search algorithm determine which half of the versions to explore next?	It calls <code>isBadVersion</code> on the middle version; if it returns true, the search continues in the left half (including mid), otherwise in the right half (excluding mid).
4	What are common pitfalls to avoid when implementing the First Bad Version solution?	Common pitfalls include incorrect pointer updates leading to infinite loops, integer overflow in midpoint calculation, and not properly handling edge cases such as when the first or last version is bad.
5	Can the First Bad Version problem concept be applied in real-world software development?	Yes, it can be applied in identifying the introduction point of bugs or defects in software version history, aiding efficient debugging and quality control.
6	What is the time complexity of the binary search solution for the First Bad Version problem?	The time complexity is $O(\log n)$, where n is the number of versions.
7	How can integer overflow be avoided when calculating the midpoint in binary search?	By using the formula $\text{mid} = \text{left} + (\text{right} - \text{left}) // 2$ instead of $\text{mid} = (\text{left} + \text{right}) // 2$.
8	What does the <code>isBadVersion</code> API represent in the context of this problem?	It is an API that returns a boolean indicating whether a specific version is bad (defective).

9	What is the 'First Bad Version' problem on LeetCode?	The 'First Bad Version' problem is a classic binary search problem where you need to find the first occurrence of a bad version in a sorted array of versions.
10	Why is binary search the optimal algorithm for solving the 'First Bad Version' problem?	Binary search is optimal for this problem because it efficiently narrows down the search space by half in each iteration, leading to a time complexity of $O(\log n)$.
11	How do you adjust the pointers in a binary search when solving the 'First Bad Version' problem?	When you find a bad version, you adjust the right pointer to `mid` to search the left half. If the middle version is good, you adjust the left pointer to `mid + 1` to search the right half.
12	What is the time and space complexity of the binary search solution for the 'First Bad Version' problem?	The time complexity is $O(\log n)$, and the space complexity is $O(1)$.
13	Can you provide a sample implementation of the 'First Bad Version' solution in Python?	Certainly! Here is a sample implementation: <pre>def firstBadVersion(n): left, right = 1, n while left < right: mid = left + (right - left) // 2 if isBadVersion(mid): right = mid else: left = mid + 1 return left</pre>

1 4	What are some practical applications of the 'First Bad Version' problem?	Understanding and solving the 'First Bad Version' problem helps you grasp the concept of binary search, which is widely used in various real-world applications, such as search engines, databases, and more.
1 5	How can mastering the 'First Bad Version' problem benefit your coding skills?	Mastering this problem enhances your problem-solving skills, particularly in understanding and applying binary search algorithms, which are crucial for efficient searching and sorting in various programming scenarios.
1 6	What is the significance of the `isBadVersion` function in the 'First Bad Version' problem?	The `isBadVersion` function is a helper function that returns true if a given version is bad and false otherwise. It is essential for determining the bad versions during the binary search process.
1 7	How do you handle edge cases in the 'First Bad Version' problem?	Edge cases, such as when all versions are good or all versions are bad, are handled naturally by the binary search algorithm. The algorithm will correctly identify the first bad version or return the appropriate result if no bad versions exist.
1 8	What are some common mistakes to avoid when solving the 'First Bad Version' problem?	Common mistakes include not adjusting the pointers correctly, leading to an infinite loop, and not handling edge cases properly. It's important to carefully implement the binary search logic and test the solution with various test cases.

algorithm optimization, binary search, binary search implementation, binary search leetcode, coding interview

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