Algorithms SV worksheet 3

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1 Trees

1. Prove that, in a binary search tree, if node n has two children, then its successor has no left child.
2. Prove that in a BST in which all nodes have either 0 or 2 children, if a key is not in a bottom node, its successor, if it exists, must be.
3. Explain insertion and deletion to a red-black tree. Please use figures instead of just writing pseudocode.

2 Hash Tables

1. Make a hash table with 8 slots and insert into it the following values: 15, 23, 12, 20, 19, 8, 7, 17, 10, 11.
   Use the hash function h(k) = (k mod 10) mod 8, and resolve collisions by chaining
2. How can you handle deletions from an open addressing table? What are the problems with the obvious naïve approach?
3. One idea to avoid handling collisions is to make the hash table large enough so that the chances of having a collision are negligible. Explain why it is not feasible.
   Hint: Birthday problem
4. Find another use of hash functions in Computer Science/Software Engineering. Explain what properties of hash functions are required for this use case, and why you also need them for hash tables.

3 Algorithm Design

Solve this Leetcode problem. You can use any programming language. Please send your code, with an explanation of your algorithm.