Leetcode: Data Structure and Algorithms

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Table of contents

## Binary Search

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| **Problem 1: Leetcode 69: Sqrt(x)**Given a non-negative integer, $x$, return the square root of $x$ rounded down to the nearest integer. The returned integer should be non-negative as well.You may not use any built-in exponent function. For example, x\*\*0.5 in python.Example:Input: x=4Output: 2 Input: x=8Output: 2Explanation: Square root of 4 is 2 and square root of 8 is 2.8284. But we need to round down to any fraction. Therefore, the square root of 8 is also 2.**Solution:**The square root of any number $x\geq 0$ is less than or equal to $x$. The brute force solution to this would be $O\left(\sqrt{n}\right)$. Because, say $x=8$, thenfor $i=1$ to 8: In contrast, if we explore binary search then the time complexity reduces to $O\left(logn\right)$. Say the square root is $s$ which is the middle value in the range of 1 to $x$. Then if $s^{2}>x$, we search for the root in the left half. Otherwise, if $s^{2}<x$ then we search the right side. However, when $s^{2}<x$, then $s$ is a possible candidate for the square root.*Algorithm:*1. set left value $l=0$, right value $r=x$
2. Compute the middle value $m=l+\left(r−l\right)/2$
3. If $m^{2}>x$ then search the left side: set $r=m−1$
4. If $m^{2}<x$ then search the right side: set $l=m+1$

def square\_root(x): l, r = 0, x  sq = 0 while l<=r: m = l + (r-l)//2  if m\*\*2 > x: r= m-1 elif m\*\*2 < x: l = m+1  sq = m else: return m  return sq  print(square\_root(6))2 |

## Array

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| **Problem 1: Intersection of two sets**Say, we are given two sets $A=\left[2,3,5,6,8\right]$ and $B=\left[4,6,8\right]$. We want to find the intersection of the elements in these sets.def intersection\_of\_two\_sets(A,B): set\_a = set(A) return [b for b in B if b in set\_a]A = [2,3,5,6,8]B = [4,6,8]print(intersection\_of\_two\_sets(A,B))[6, 8] |

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| **Problem 2: Histogram from a given array and bin number**Say, we are given an array $A=\left[1,2,2,3,3,3,4,4,4,4,5,5,5,5,5\right]$ and number of bins. We want todef generate\_histogram(A, num\_bins): min\_value = min(A) max\_value = max(A) bin\_width = (max\_value-min\_value)/num\_bins |

## String

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| **Problem 1: Leetcode 242: Valid Anagram**Given two strings s and t, return true if t is an *anagram* of s, and false *otherwise*Example: Input: s="anagram", t="nagaram" Output: trueSince the word anagram has 3 a’s, 1 n, 1 g, 1 r, and 1 m and nagaram has exactly the same number of the same alphabets, therefore they are anagram of each other.Example: Input: s="rat", t="cat" Output: falseSince the word rat has 1 r, 1 a, and 1 t but cat has 2 elements same as rat but one element different. Therefore the answer is false.Note that, they both have the same length.**Constraints:*** $1\leq s$.length, $t$.length $\leq 5×10^{4}$
* s and t consists of lowercase English letters

**Solution:**We can use hasmap to solve this problem. Basically, we will create two hasmaps for two words and match the keys and values of the hasmaps. If they are equal then it’s an anagram, otherwise not.def isAnagram(s,t): if len(s) != len(t): return False   hash\_s, hash\_t = {}, {} for i in range(len(s)): hash\_s[s[i]] = 1 + hash\_s.get(s[i],0) # get function collects the key and values. hash\_t[t[i]] = 1 + hash\_t.get(t[i],0) # if there's no key, 0 is the default value  for c in hash\_s: if hash\_s[c] != hash\_t.get(c,0): # Here, get function ensures there is no  return False # key error return Trues = "anagram"t = "nagaram"print(isAnagram(s,t))u = "rat"print(isAnagram(s,u))TrueFalse**Time and Space Complexity:**Time complexity $O\left(m+n\right)$ where $m$ and $n$ are the length of s and t and memory complexity is the same $O\left(m+n\right)$Optimization: Can we solve the problem in $O\left(1\right)$? If we assume sort doesn’t require extra space, thendef isAnagram(s,t): return sorted(s)== sorted(t)s= "anagram"t= "nagaram"print(isAnagram(s,t))True |

## Reference

All my solutions here are based on the solutions found from [NeetCode](https://www.youtube.com/c/neetcode).