

Leetcode 2: Add Two Numbers

```
1 import utils as U
2
3 class ListNode:
4     def __init__(self, val=0, next=None):
5         self.val = val
6         self.next = next
7
8 class Solution:
9     def addTwoNumbers(self, l1: ListNode, l2: ListNode) -> ListNode:
10         if l1 is None: return l2
11         if l2 is None: return l1
12
13         n1 = l1
14         n2 = l2
15         carry = 0
16         solution_head = solution_node = ListNode()
17
18         while n1 or n2 or (carry > 0):
19             solution_node.next = ListNode()
20             solution_node = solution_node.next
21
22             v1 = v2 = 0
23             if n1:
24                 v1 = n1.val
25                 n1 = n1.next
26
27             if n2:
28                 v2 = n2.val
29                 n2 = n2.next
30
31             tot = v1 + v2 + carry
32             carry = tot // 10
33             solution_node.val = tot % 10
34
35         return solution_head.next
```

Leetcode 3: Longest Substring Wo Repeat Chars

```
1 class Solution:
2     def repeatchar(self, substr):
3         seen = {}
4         for c in substr:
5             if c in seen:
6                 return True
7             else:
8                 seen[c] = 1
9         return False
10
11 def lengthOfLongestSubstring_bruteforce(self, s: str) -> int:
12     n = len(s)
13     best = 0
14     for i in range(n):
15         for j in range(i + 1, n + 1):
16             if j - i <= best: continue
17             substr = s[i: j]
18             if self.repeatchar(substr):
19                 break
20             length = j - i
21             if length > best:
22                 best = length
23     return best
24
25 def lengthOfLongestSubstring(self, s: str) -> int:
26     chars = [0] * 128
27     left = right = 0
28     res = 0
29     while right < len(s):
30         r = s[right]
31         chars[ord(r)] += 1
32
33         while chars[ord(r)] > 1:
34             l = s[left]
35             chars[ord(l)] -= 1
36             left += 1
37
38         res = max(res, right - left + 1)
39
40         right += 1
41     return res
```

Leetcode 4: Median Of Two Sorted Arrays

```
1 from typing import List
2 import numpy as np
3
4 class Solution:
5     def findMedianSortedArrays(self, nums1: List[int], nums2: List[int]) -> float:
6         n1 = len(nums1)
7         n2 = len(nums2)
8
9         if n1 == n2 == 0:
10             raise ValueError('both arrays empty')
11
12         p = q = 0
13         result = []
14         while (p < n1) and (q < n2):
15             if nums1[p] < nums2[q]:
16                 result.append(nums1[p])
17                 p += 1
18             else:
19                 result.append(nums2[q])
20                 q += 1
21
22         if p == n1:
23             result.extend(nums2[q:])
24
25         if q == n2:
26             result.extend(nums1[p:])
27
28         mid = (n1 + n2) // 2
29         if (n1 + n2) % 2 == 0:
30             return 0.5 * (result[mid] + result[mid - 1])
31         else:
32             return result[mid]
```

Leetcode 5: Longest Palindromic Substring

```
1 class Solution:
2     def longestPalindrome(self, s: str) -> str:
3         n = len(s)
4         T = [[0 for _ in range(n)] for _ in range(n)]
5         T[0][0] = 1
6         for i in range(1, n):
7             T[i][i] = 1
8             T[i - 1][i] = int(s[i - 1] == s[i])
9
10        for w in range(2, n):
11            for i in range(n - w):
12                j = i + w
13                if (T[i + 1][j - 1] == 1) and (s[i] == s[j]):
14                    T[i][j] = 1
15
16        # Now find the index (i, j) s.t. T[i, j] == 1 and (j - i) is largest
17        mi = mj = 0
18        for i in range(n):
19            for j in range(i, n):
20                if (T[i][j] == 1) and (j - i > mj - mi):
21                    mi, mj = i, j
22        return s[mi: mj + 1]
```

Leetcode 6: Zigzag Conversion

```
1 class Solution:
2     def convert(self, s: str, numRows: int) -> str:
3         if numRows < 2: return s
4
5         rows = [[] for _ in range(numRows)]
6
7         i = 0
8         incr = 1
9         for c in s:
10            rows[i].append(c)
11            if i == 0:
12                incr = 1
13            if i == numRows - 1:
14                incr = -1
15            i += incr
16
17         res = ''
18         for r in rows:
19             res += ''.join(r)
20         return res
```

Leetcode 7: Reverse Integer

```
1 class Solution:
2     def greater(self, s1, s2):
3         l1 = len(s1)
4         l2 = len(s2)
5         if l1 != l2:
6             return l1 > l2
7
8         # equal lengths
9         i = 0
10        while s1[i] == s2[i]:
11            i += 1
12        return s1[i] > s2[i]
13
14    def reverse(self, x: int) -> int:
15        MAXN = str(1 << 31)
16        MAXP = str((1 << 31) - 1)
17        positive = (x >= 0)
18        s = str(abs(x))
19        r = ''.join(reversed(s))
20
21        val = 0
22        if positive:
23            if not self.greater(r, MAXP):
24                val = int(r)
25        else:
26            if not self.greater(r, MAXN):
27                val = -int(r)
28        return val
```

Leetcode 8: Atoi

```
1 class Solution:
2     def greater(self, s1, s2):
3         l1 = len(s1)
4         l2 = len(s2)
5         if l1 != l2:
6             return l1 > l2
7
8         i = 0
9         while (i < l1) and (s1[i] == s2[i]):
10             i += 1
11         if i == l1:
12             return True
13
14         return s1[i] > s2[i]
15
16     def myAtoi(self, s: str) -> int:
17         if s == '':
18             return 0
19
20         # Strip all leading whitespace
21         i = 0
22         while (i < len(s)) and (s[i] == ' '):
23             i += 1
24         s = s[i:]
25
26         if s == '':
27             return 0
28
29         if s[0] == '-':
30             sign = -1
31             s = s[1:]
32         elif s[0] == '+':
33             sign = 1
34             s = s[1:]
35         else:
36             sign = 1
37
38         # Strip all leading zeros
39         if s == '':
40             return 0
41
42         i = 0
43         while (i < len(s)) and (s[i] == '0'):
44             i += 1
45         s = s[i:]
46
47         digits = ''
48         for c in s:
49             if c not in list('0123456789'):
50                 break
51
52             digits += c
53
54         if digits == '':
55             return 0
56
57         MAXP = str((1 << 31) - 1)
58         MAXN = str((1 << 31))
59         if sign == -1:
60             if self.greater(digits, MAXN):
61                 return -int(MAXN)
62
63         if sign == 1:
64             if self.greater(digits, MAXP):
65                 return int(MAXP)
66         return sign * int(digits)
```

Leetcode 12: Integer To Roman

```
1 class Solution:
2     def convert(self, b):
3         table = {
4             1: 'I',
5             2: 'II',
6             3: 'III',
7             4: 'IV',
8             5: 'V',
9             6: 'VI',
10            7: 'VII',
11            8: 'VIII',
12            9: 'IX',
13            10: 'X',
14            20: 'XX',
15            30: 'XXX',
16            40: 'XL',
17            50: 'L',
18            60: 'LX',
19            70: 'LXX',
20            80: 'LXXX',
21            90: 'XC',
22            100: 'C',
23            200: 'CC',
24            300: 'CCC',
25            400: 'CD',
26            500: 'D',
27            600: 'DC',
28            700: 'DCC',
29            800: 'DCCC',
30            900: 'CM',
31            1000: 'M',
32            2000: 'MM',
33            3000: 'MMM'
34        }
35
36        return table[b]
37
38    def intToRoman(self, num: int) -> str:
39
40        # Get digits for units, tens, hundreds and thous
41        n = num
42        parts = []
43        ex = 1
44        while n > 0:
45            r = n % 10
46            parts.append(r * ex)
47            n //= 10
48            ex *= 10
49
50        parts.reverse()
51        s = []
52        for p in parts:
53            if p > 0:
54                s.append(self.convert(p))
55        return ''.join(s)
```


Leetcode 13: Roman To Integer

```
1 class Solution:
2     def romanToInt(self, s: str) -> int:
3         if s == '': return 0
4
5         SYMBOLS_MAP = {
6             'I': 1,
7             'IV': 4,
8             'V': 5,
9             'IX': 9,
10            'X': 10,
11            'XL': 40,
12            'L': 50,
13            'XC': 90,
14            'C': 100,
15            'CD': 400,
16            'D': 500,
17            'CM': 900,
18            'M': 1000
19        }
20
21        SYMBOLS_LIST = ['I', 'V', 'X', 'L', 'C', 'D', 'M']
22        symbols = []
23        n = len(s)
24        i = 0
25        while i <= n - 2:
26            current = s[i]
27            nxt = s[i + 1]
28            if SYMBOLS_LIST.index(nxt) > SYMBOLS_LIST.index(current):
29                # Special symbol
30                symbols.append(current + nxt)
31                i += 2
32            else:
33                symbols.append(current)
34                i += 1
35
36        if i == n - 1:
37            symbols.append(s[i])
38
39        return sum(SYMBOLS_MAP[k] for k in symbols)
```

Leetcode 15: 3sum

```
1 from typing import List, Dict
2
3 class Solution:
4     def threeSum(self, nums: List[int]) -> List[List[int]]:
5         MAP = {}
6         for i in nums:
7             if i in MAP:
8                 MAP[i] += 1
9             else:
10                MAP[i] = 1
11
12        n = len(nums)
13        result = set()
14        seen = set()
15        for i in range(n):
16            ei = nums[i]
17
18            if ei in seen: continue
19            seen.add(ei)
20
21            for j in range(i + 1, n):
22                ej = nums[j]
23                ek = -ei - ej
24                MAP[ei] -= 1
25                MAP[ej] -= 1
26                if MAP.get(ek, 0) > 0:
27                    t = tuple(sorted([ei, ej, ek]))
28                    result.add(t)
29                MAP[ei] += 1
30                MAP[ej] += 1
31        result = [list(t) for t in result]
32        return result
```

Leetcode 16: 3sum Closest

```
1 from typing import List
2
3 class Solution:
4     def find_closest_elem(self, list_, num):
5         n = len(list_)
6         left = 0
7         right = n - 1
8         mid = (left + right) // 2
9         while left < right:
10             mid = (left + right) // 2
11             emid = list_[mid]
12             if num == emid:
13                 return num
14
15             if num > emid:
16                 left = mid + 1
17             elif num < emid:
18                 right = mid - 1
19
20         if abs(list_[mid] - num) < abs(list_[right] - num):
21             return list_[mid]
22         else:
23             return list_[right]
24
25     def threeSumClosest(self, nums: List[int], target: int) -> int:
26         nums.sort()
27         nums2sum = []
28         n = len(nums)
29         for i in range(n):
30             for j in range(i + 1, n):
31                 nums2sum.append((i, j, nums[i] + nums[j]))
32         nums2sum.sort(key=lambda x: x[2])
33
34         best_err = float('inf')
35         best_sum = -1
36         for i in range(n):
37             ni = nums[i]
38             sk = self.find_closest_elem(nums2sum, target - ni)
39             sum_ = ni + sk
40             err = abs(target - sum_)
41             if err < best_err:
42                 best_err = err
43                 best_sum = sum_
44
45             if err == 0: break
46
47         return best_sum
```

Leetcode 17: Letter Combinations Of Phone Number

```
1 from typing import List
2
3 class Solution:
4     def __init__(self):
5         self.strs = []
6         self.MAP = {
7             '2': ['a', 'b', 'c'],
8             '3': ['d', 'e', 'f'],
9             '4': ['g', 'h', 'i'],
10            '5': ['j', 'k', 'l'],
11            '6': ['m', 'n', 'o'],
12            '7': ['p', 'q', 'r', 's'],
13            '8': ['t', 'u', 'v'],
14            '9': ['w', 'x', 'y', 'z']
15        }
16
17    def _func(self, digits, str_):
18        if digits == '':
19            self.strs.append(str_)
20            return
21
22        d = digits[0]
23        for c in self.MAP[d]:
24            self._func(digits[1:], str_ + c)
25
26    def letterCombinations(self, digits: str) -> List[str]:
27        digits = digits.strip()
28        if digits == '': return []
29
30        self._func(digits, '')
31        return self.strs
```

Leetcode 19: Remove Nth Node From End Of List

```
1 from typing import List
2
3 # Definition for singly-linked list.
4 class ListNode:
5     def __init__(self, val=0, next=None):
6         self.val = val
7         self.next = next
8 class Solution:
9     def removeNthFromEnd(self, head: ListNode, n: int) -> ListNode:
10         node = head
11         cache = []
12         while node:
13             cache.append(node)
14             if len(cache) > n + 1:
15                 cache.pop(0)
16             node = node.next
17
18         if n == len(cache):
19             return head.next
20
21         if n == 1:
22             cache[0].next = None
23         else:
24             cache[0].next = cache[2]
25
26         return head
27
28 def linkedlist_to_list(head: ListNode):
29     node = head
30     v = []
31     while node:
32         v.append(node.val)
33         node = node.next
34     return v
35
36 def list_to_linkedlist(lst):
37     head = ListNode()
38     node = head
39     n = len(lst)
40     for i in range(n - 1):
41         node.val = lst[i]
42         node.next = ListNode()
43         node = node.next
44     node.val = lst[-1]
45     return head
```

Leetcode 21: Merge Two Sorted Linked Lists

```
1 # Definition for singly-linked list.
2 class ListNode:
3     def __init__(self, val=0, next=None):
4         self.val = val
5         self.next = next
6
7 class Solution:
8     def mergeTwoLists(self, l1: ListNode, l2: ListNode) -> ListNode:
9         head = node = ListNode()
10
11         p = l1
12         q = l2
13
14         while p and q:
15             node.next = ListNode()
16             node = node.next
17
18             if p.val < q.val:
19                 node.val = p.val
20                 p = p.next
21             else:
22                 node.val = q.val
23                 q = q.next
24
25         if p: node.next = p
26         if q: node.next = q
27
28         return head.next
```

Leetcode 23: Merge K Sorted Lists

```
1 from typing import List
2 from heapq import heapify, heappop, heappush
3
4 # Definition for singly-linked list.
5 class ListNode:
6     def __init__(self, val=0, next=None):
7         self.val = val
8         self.next = next
9 class Solution:
10     def mergeKLists(self, lists: List[ListNode]) -> ListNode:
11         # Initialize heap
12         minheap = []
13         for listnum, head in enumerate(lists):
14             if head:
15                 item = (head.val, listnum, head)
16                 minheap.append(item)
17         heapify(minheap)
18
19         newhead = sortednode = ListNode()
20
21         # Main loop
22         while minheap:
23             sortednode.next = ListNode()
24             sortednode = sortednode.next
25
26             # Pop min val from heap
27             val, listnum, node = heappop(minheap)
28             sortednode.val = val
29             if node.next:
30                 heappush(minheap, (node.next.val, listnum, node.next))
31
32         return newhead.next
```

Leetcode 24: Swap Nodes In Pairs

```
1 # Definition for singly-linked list.
2 class ListNode:
3     def __init__(self, val=0, next=None):
4         self.val = val
5         self.next = next
6
7
8 class Solution:
9     def swapPairsWithVal(self, head: ListNode) -> ListNode:
10         node = head
11         while node and node.next:
12             node.val, node.next.val = node.next.val, node.val
13             node = node.next.next
14         return head
15
16     def swapPairs(self, head: ListNode) -> ListNode:
17         cur = head
18         prev = None
19         newhead = None
20         while cur and cur.next:
21             nxt = cur.next
22             if not newhead:
23                 newhead = nxt
24
25             tmp = nxt.next
26             cur.next = tmp
27
28             if prev:
29                 prev.next = nxt
30
31             nxt.next = cur
32             prev = cur
33             cur = tmp
34
35         if not newhead:
36             newhead = head
37
38         return newhead
```


Leetcode 25: Reverse Nodes In K Groups

```
1 # Definition for singly-linked list.
2 class ListNode:
3     def __init__(self, val=0, next=None):
4         self.val = val
5         self.next = next
6 class Solution:
7     def reverse(self, head):
8         """Reverse a linked list in O(1) space"""
9         if not head:
10             return None
11
12         prev = head
13         curr = head.next
14         while curr:
15             nxt = curr.next
16             curr.next = prev
17             prev = curr
18             curr = nxt
19
20         head.next = None
21         return prev
22
23     def reverseKGroup(self, head: ListNode, k: int) -> ListNode:
24         dumminode = ListNode()
25         prev = dumminode
26         curr = head
27         while curr:
28             n = 0
29             cprev = node = curr
30             while node and n < k:
31                 cprev = node
32                 node = node.next
33                 n += 1
34
35             if n < k: # i.e. node is None
36                 break
37
38             cnxt = node
39             cprev.next = None
40             chead = self.reverse(curr)
41             prev.next = chead
42             curr.next = cnxt
43             prev = curr
44             curr = cnxt
45         return dumminode.next
```

Leetcode 26: Remove Duplicates From Sorted Array

```
1 from typing import List
2
3 class Solution:
4     def removeDuplicates(self, nums: List[int]) -> int:
5         n = len(nums)
6         i = 1
7         while i < n:
8             if nums[i - 1] == nums[i]:
9                 nums.pop(i)
10                n -= 1
11            else:
12                i += 1
13
14        return n
```

Leetcode 27: Generate Parentheses

```
1 from typing import List
2
3 class Solution:
4     def __init__(self):
5         self.plist = []
6
7     def helper(self, s, nl, nr):
8         if (nl == 0) and (nr == 0):
9             self.plist.append(s)
10            return
11
12        # No matter what state, the parens are valid
13        # if you open one more.
14        if nl > 0:
15            self.helper(s + '(', nl - 1, nr)
16
17
18        # If the last paren is '(', then closing it
19        # is always valid
20        if s[-1] == '(':
21            if nr > 0:
22                self.helper(s + ')', nl, nr - 1)
23
24        # If last paren is ')', then you can close
25        # one more if number of open parens is >
26        # number of closed parens
27        if s[-1] == ')':
28            if nl < nr:
29                self.helper(s + ')', nl, nr - 1)
30
31    def generateParenthesis(self, n: int) -> List[str]:
32        self.helper('(', n - 1, n)
33        return self.plist
```

Leetcode 27: Remove Element

```
1 from typing import List
2
3 class Solution:
4     def removeElement(self, nums: List[int], val: int) -> int:
5         n = len(nums)
6         i = j = 0
7         for i in range(n):
8             if nums[i] != val:
9                 nums[j] = nums[i]
10                j += 1
11        return j
```

Leetcode 28: Implement Strstr

```
1 class Solution:
2     def strstr(self, haystack: str, needle: str) -> int:
3         n = len(haystack)
4         m = len(needle)
5
6         if m == 0: return 0
7
8         i = 0
9         while i <= n - m:
10             j = 0
11             idx = i
12             while (i < n) and (j < m) and (haystack[i] == needle[j]):
13                 print(i, j, haystack[i], needle[j])
14                 i += 1
15                 j += 1
16
17             if j == m:
18                 return idx
19
20             i = idx + 1
21
22         return -1
```

Leetcode 30: Substring With Concatenation Of All Words

```
1 from typing import List
2
3 class Solution:
4     def findSubstring(self, s: str, words: List[str]) -> List[int]:
5         n = len(s)
6         w = len(words)
7         k = len(words[0])
8         whash = hash(''.join(sorted(words)))
9         indices = []
10        for i in range(n - k * w + 1):
11            substr = s[i: i + k * w]
12            substr_words = [substr[j: j + k] for j in range(0, k * w, k)]
13            substr_words_hash = hash(''.join(sorted(substr_words)))
14            if whash == substr_words_hash:
15                indices.append(i)
16
17        return indices
```

Leetcode 33: Search In Rotated Sorted Array

```
1 from typing import List
2
3 class Solution:
4     def findPivot(self, nums):
5         n = len(nums)
6         left = 0
7         right = n - 1
8         while left < right:
9             mid = (left + right) // 2
10            if nums[mid] > nums[left]:
11                left = mid
12            else:
13                right = mid
14
15        return left
16
17    def binarySearch(self, nums, target):
18        n = len(nums)
19        left = 0
20        right = n - 1
21        while left <= right:
22            mid = (left + right) // 2
23            if nums[mid] < target:
24                left = mid + 1
25            elif nums[mid] > target:
26                right = mid - 1
27            else:
28                return mid
29        return -1
30
31    def search(self, nums: List[int], target: int) -> int:
32        pivot = self.findPivot(nums) + 1
33        left_array = nums[:pivot]
34        right_array = nums[pivot:]
35        if (idx := self.binarySearch(left_array, target)) != -1:
36            return idx
37        if (idx := self.binarySearch(right_array, target)) != -1:
38            return pivot + idx
39        return -1
```

Leetcode 34: Find First And Last Position Of Element In Sorted Array

```
1 from typing import List
2
3
4 class Solution:
5     def find(self, nums, target, kind):
6         n = len(nums)
7         left, right = 0, n - 1
8         while left <= right:
9             mid = (left + right) // 2
10            if nums[mid] < target:
11                left = mid + 1
12            elif nums[mid] > target:
13                right = mid - 1
14            else: # nums[mid] == target
15
16                if kind == 'left': # Leftmost bound requested
17                    if (mid == 0) or (nums[mid - 1] < target):
18                        return mid
19                    right = mid - 1
20
21                if kind == 'right': # rightmost bound requested
22                    if (mid == n - 1) or (nums[mid + 1] > target):
23                        return mid
24                    left = mid + 1
25
26            return -1
27
28 def searchRange(self, nums: List[int], target: int) -> List[int]:
29     leftlim = self.find(nums, target, 'left')
30     if leftlim == -1:
31         return [-1, -1]
32     rightlim = self.find(nums, target, 'right')
33
34     return [leftlim, rightlim]
```


Leetcode 35: Search Insert Position

```
1 from typing import List
2
3 class Solution:
4     def searchInsert(self, nums: List[int], target: int) -> int:
5         n = len(nums)
6         left, right = 0, n - 1
7         mid = -1
8         found = False
9         while left <= right:
10             mid = (left + right) // 2
11             if nums[mid] < target:
12                 left = mid + 1
13             elif nums[mid] > target:
14                 right = mid - 1
15             else:
16                 found = True
17                 break
18
19         if found:
20             return mid
21
22         if left == n - 1:
23             if target > nums[n - 1]:
24                 return n
25             else:
26                 return n - 1
27
28         if right == 0:
29             if target < nums[0]:
30                 return 0
31             else:
32                 return 1
33
34         if right < mid:
35             return mid
36         elif left > mid:
37             return left
```

Leetcode 36: Valid Sudoku

```
1 from typing import List
2
3 class Solution:
4     def isvalid(self, block):
5         dct = dict.fromkeys(range(1, 10), 0)
6         for digit in block:
7             if digit == '.':
8                 continue
9             try:
10                 digit = int(digit)
11             except ValueError:
12                 return False
13
14             if not (1 <= digit <= 9):
15                 return False
16
17             dct[digit] += 1
18             if dct[digit] > 1:
19                 return False
20
21         return True
22
23 def isValidSudoku(self, board: List[List[str]]) -> bool:
24     # Rows
25     for row in board:
26         if not self.isvalid(row):
27             return False
28
29     # Columns
30     for col in range(9):
31         column = [row[col] for row in board]
32         if not self.isvalid(column):
33             return False
34
35     # 3x3 blocks
36     for row in [0, 3, 6]:
37         for col in [0, 3, 6]:
38             block = [board[row + i][col + j] for i in range(3) for j in range(3)]
39             if not self.isvalid(block):
40                 return False
41     return True
```

Leetcode 37: Sudoku Solver

```
1 from typing import List
2
3 def checkvalid(board, row, col, digit):
4     for i in range(9):
5         if (board[i][col] == digit) or (board[row][i] == digit): return False
6     r0 = (row // 3) * 3
7     c0 = (col // 3) * 3
8     block = [board[r0 + i][c0 + j] for i in range(3) for j in range(3)]
9     if digit in block: return False
10    return True
11
12 class Solution1:
13     def __init__(self):
14         self.solved = False
15
16     def sudokuHelper(self, board, positions, idx, digit):
17         i, j = positions[idx]
18         if not checkvalid(board, i, j, digit):
19             return
20         board[i][j] = digit
21
22         # Base case
23         if idx == len(positions) - 1:
24             self.solved = True
25             return
26
27         d = 1
28         while d <= 9 and (not self.solved):
29             self.sudokuHelper(board, positions, idx + 1, str(d))
30             d += 1
31
32         if not self.solved:
33             pi, pj = positions[idx + 1]
34             board[pi][pj] = '.'
35
36     def solveSudoku(self, board):
37         positions = [(row, col) for row in range(9) for col in range(9) if board[row][col] == '.']
38         for d in range(1, 10):
39             if not self.solved:
40                 self.sudokuHelper(board, positions, 0, str(d))
41
42 class Solution2:
43     def __init__(self):
44         self.solved = False
45
46     def sudokuHelper(self, board, positions, idx):
47         if idx == len(positions):
48             self.solved = True
49             return
50
51         i, j = positions[idx]
52         for d in list('123456789'):
53             if self.solved: return
54             if not checkvalid(board, i, j, d): continue
55             board[i][j] = d
56             self.sudokuHelper(board, positions, idx + 1)
57
58         if not self.solved:
59             board[i][j] = '.'
60
61     def solveSudoku(self, board):
62         positions = [(row, col) for row in range(9) for col in range(9) if board[row][col] == '.']
63         self.sudokuHelper(board, positions, 0)
64
65     def printboard(board):
66         print('\n')
67         for r in board:
68             print(r)
69
```

Leetcode 38: Count And Say

```
1 class Solution:
2     def helper(self, s):
3         s += '_'
4         n = len(s)
5         digit_counts = []
6         i = 0
7         while i < n - 1:
8             count = 1
9             while s[i] == s[i + 1]:
10                 count += 1
11                 i += 1
12
13             digit_counts.append((s[i], count))
14             i += 1
15         out = ''
16         for digit, count in digit_counts:
17             out += f'{count}{digit}'
18         return out
19
20     def countAndSay(self, n: int) -> str:
21         css = '1'
22         for i in range(1, n):
23             css = self.helper(css)
24         return css
```

Leetcode 39: Combination Sum

```
1 from typing import List
2 from collections import deque
3
4 class Solution:
5     def combinationSum(self, candidates: List[int], target: int) -> List[List[int]]:
6         queue = deque()
7         combinations = set()
8         candidates.sort()
9
10        # Initial setup
11        for val in candidates:
12            item = (target, val, ())
13            queue.appendleft(item)
14
15        # Main BFS loop
16        while queue:
17            curr_target, curr_val, curr_comb = queue.pop()
18            new_target = curr_target - curr_val
19            if new_target < 0: continue
20
21            new_comb = curr_comb + (curr_val, )
22            new_comb = tuple(sorted(new_comb))
23
24            # Found a solution
25            if new_target == 0:
26                combinations.add(new_comb)
27                continue
28
29            # Continue BFS exploration
30            for val in candidates:
31                if val > new_target:
32                    continue
33                new_item = (new_target, val, new_comb)
34                queue.appendleft(new_item)
35
36        return [list(c) for c in combinations]
37
38 class Solution2:
39     def __init__(self):
40         self.combinations = set()
41
42     def helper(self, candidates, target, combination):
43         # Base cases
44         if target < 0: return
45
46         if target == 0:
47             self.combinations.add(tuple(sorted(combination)))
48             return
49
50         # DFS
51         for c in candidates:
52             if c <= target:
53                 self.helper(candidates, target - c, combination + [c])
54
55     def combinationSum(self, candidates: List[int], target: int) -> List[List[int]]:
56         self.helper(candidates, target, [])
57         ret = [list(t) for t in self.combinations]
58         return ret
```

Leetcode 40: Combination Sum 2

```
1 from typing import List
2
3
4 class Solution:
5     def __init__(self):
6         self.combinations = set()
7         self.visited = set()
8
9     def helper(self, candidates, target, combination):
10        if target < 0: return
11        if target == 0:
12            self.combinations.add(combination)
13            return
14
15        n = len(candidates)
16        for i in range(n):
17            c = candidates[i]
18            if c <= target:
19                newcandidates = tuple(candidates[k] for k in range(n) if (k != i and candidates[k] < target))
20                new_combination = tuple(sorted(combination + (c, )))
21                item = (newcandidates, target - c, new_combination)
22                if not (item in self.visited):
23                    self.visited.add(item)
24                    self.helper(*item)
25
26    def combinationSum2(self, candidates: List[int], target: int) -> List[List[int]]:
27        candidates.sort()
28        self.helper(candidates, target, ())
29        return [list(t) for t in self.combinations]
```

Leetcode 41: First Missing Positive

```
1 from typing import List
2
3 class Solution:
4     def firstMissingPositive(self, nums: List[int]) -> int:
5         table = [-1] * 301
6         # create list of positives
7         for i in nums:
8             if 0 < i < 301:
9                 table[i] = 1
10        for j in range(1, 301):
11            if table[j] == -1:
12                return j
13
14 class Solution2:
15     def firstMissingPositive(self, nums: List[int]) -> int:
16         B = 0
17         # create list of positives
18         for i in nums:
19             if 0 < i < 301:
20                 B |= (1 << i)
21
22         for i in range(1, 301):
23             if B & (1 << i) == 0:
24                 return i
```

Leetcode 42: Trapping Rain Water

```
1 from typing import List
2
3 class Solution:
4     def trap(self, height: List[int]) -> int:
5         n = len(height)
6         if n == 0: return 0
7
8         leftmax = [0] * n
9         rightmax = [0] * n
10
11         leftmax[0] = height[0]
12         rightmax[-1] = height[-1]
13         for i in range(1, n):
14             leftmax[i] = max(leftmax[i - 1], height[i])
15
16         for i in range(n - 2, -1, -1):
17             rightmax[i] = max(rightmax[i + 1], height[i])
18
19         vol = 0
20         for i in range(n):
21             vol += min(leftmax[i], rightmax[i]) - height[i]
22
23         return vol
```


Leetcode 43: Multiply Strings

```
1 from typing import List
2
3 class Solution:
4     def add(self, L1: List, L2: List):
5         assert len(L1) == len(L2), 'Lists have unequal length'
6         n = len(L1)
7         carry = 0
8         ret = [0] * n
9         for i in range(n):
10             tot = L1[i] + L2[i] + carry
11             carry = tot // 10
12             unit = tot % 10
13             ret[i] = unit
14         return ret
15
16     def multiply(self, num1: str, num2: str) -> str:
17         if (num1 == '0') or (num2 == '0'): return '0'
18         n1 = len(num1)
19         n2 = len(num2)
20         n = n1 + n2 + 1
21         ans = [0] * n
22
23         num1 = num1[::-1]
24         num2 = num2[::-1]
25         for power, c2 in enumerate(num2):
26             carry = 0
27             buf = [0] * n
28             for i, c1 in enumerate(num1):
29                 d1 = int(c1)
30                 d2 = int(c2)
31                 # if (d1 == 0) or (d2 == 0): continue
32
33                 v = d1 * d2 + carry
34                 carry = v // 10 # new carry
35                 unit = v % 10
36                 idx = power + i
37                 buf[idx] = unit
38                 buf[idx + 1] = carry
39             ans = self.add(ans, buf)
40
41         # Strip leading zeros from answer
42         ans.reverse()
43         i = 0
44         while ans[i] == 0:
45             i += 1
46         ans = ans[i:]
47
48         # Create string and return
49         return ''.join([str(c) for c in ans])
```

Leetcode 45: Jump Game 2

```
1 from typing import List
2
3 class Solution:
4     def jump(self, nums: List[int]) -> int:
5         n = len(nums)
6         MAX = 1001
7         T = [MAX] * n
8         T[0] = 0
9
10        # Main loop
11        for i in range(1, n):
12            for j in range(i):
13                if nums[j] >= i - j:
14                    T[i] = min(T[i], T[j] + 1)
15
16        return T[-1]
```

Leetcode 46: Permutations

```
1 from typing import List
2
3 class Solution:
4     def helper(self, perm, indices):
5         if len(indices) == 1:
6             yield perm + indices
7
8         for i in indices:
9             newperm = perm + [i]
10            newindices = [j for j in indices if j != i]
11            yield from self.helper(newperm, newindices)
12
13    def permute(self, nums: List[int]) -> List[List[int]]:
14        indices = list(range(len(nums)))
15        permgenerator = self.helper([], indices)
16
17        # Construct permuted lists from permutation indices
18        ans = []
19        for idx in permgenerator:
20            perm = [nums[i] for i in idx]
21            ans.append(perm)
22        return ans
```

Leetcode 47: Permutations 2

```
1 from typing import List
2
3 class Solution:
4     def __init__(self):
5         self.seen = set()
6
7     def helper(self, perm, elems):
8         if len(elems) == 1:
9             yield list(perm + elems)
10
11         n = len(elems)
12         for i in range(n):
13             newperm = perm + (elems[i], )
14             newelems = tuple([elems[j] for j in range(n) if j != i])
15             newitem = (newperm, newelems)
16             if not (newitem in self.seen):
17                 self.seen.add(newitem)
18                 yield from self.helper(*newitem)
19
20     def permuteUnique(self, nums: List[int]) -> List[List[int]]:
21         permgen = self.helper((), tuple(nums))
22         answer = []
23         for p in permgen:
24             answer.append(p)
25         return answer
```

Leetcode 48: Rotate Image

```
1 from typing import List
2
3 class Solution:
4     def rotate(self, matrix: List[List[int]]) -> None:
5         """
6         Do not return anything, modify matrix in-place instead.
7         """
8         n = len(matrix)
9         for i in range(n):
10             for j in range(i, n - i - 1):
11                 tmp = matrix[i][j]
12                 matrix[i][j] = matrix[n - 1 - j][i]
13                 matrix[n - 1 - j][i] = matrix[n - 1 - i][n - 1 - j]
14                 matrix[n - 1 - i][n - 1 - j] = matrix[j][n - 1 - i]
15                 matrix[j][n - 1 - i] = tmp
```

Leetcode 49: Group Anagrams

```
1 from typing import List
2
3 class Solution:
4     def groupAnagrams(self, strs: List[str]) -> List[List[str]]:
5         anagram_dict = {}
6         for s in strs:
7             key = ''.join(sorted(s))
8             if key in anagram_dict:
9                 anagram_dict[key].append(s)
10            else:
11                anagram_dict[key] = [s]
12        return list(anagram_dict.values())
```

Leetcode 50: Pow(x, n)

```
1 class Solution:
2     def myPow(self, x: float, n: int) -> float:
3         if n == 0:
4             return 1
5         if n < 0:
6             x = 1. / x
7
8         n = abs(n)
9         if n % 2 == 0:
10            return self.myPow(x * x, n // 2)
11        else:
12            return x * self.myPow(x * x, (n - 1) // 2)
```

Leetcode 51: Nqueens

```
1 from typing import List
2 from copy import deepcopy
3
4 class Solution:
5     def check(self, board, row, col, n):
6         # Row check
7         for c in range(col):
8             if board[row][c] == 'Q':
9                 return False
10
11         for c in range(col):
12             for r in range(n):
13                 # 45 degree diag
14                 if (r + c == row + col) and (board[r][c] == 'Q'):
15                     return False
16
17                 # 135 degree diag
18                 if (r - c == row - col) and (board[r][c] == 'Q'):
19                     return False
20
21         return True
22
23     def helper(self, board, col, n):
24         if col == n:
25             yield deepcopy(board)
26
27         for row in range(n):
28             if self.check(board, row, col, n):
29                 board[row][col] = 'Q'
30                 yield from self.helper(board, col + 1, n)
31
32         if col < n:
33             board[row][col] = '.'
34
35     def solveNQueens(self, n: int) -> List[List[str]]:
36         board = [['.' for _ in range(n)] for _ in range(n)]
37         gen = self.helper(board, 0, n)
38         for sol in gen:
39             print(sol)
40
41         # solutions = []
42         # for sol in gen:
43         #     l = [''.join(r) for r in sol]
44         #     solutions.append(l)
45         # return solutions
```


Leetcode 52: Nqueens 2

```
1 class Solution:
2     def __init__(self):
3         self.numsol = 0
4
5     def valid(self, board, row, col):
6         n = len(board)
7         for i in range(col):
8             if board[row][i] == 1:
9                 return False
10
11         for c in range(col):
12             for r in range(n):
13                 if (r + c == row + col) and (board[r][c] == 1):
14                     return False
15                 if (r - c == row - col) and (board[r][c] == 1):
16                     return False
17
18         return True
19
20     def helper(self, board, col):
21         n = len(board)
22         if col == n:
23             self.numsol += 1
24             return
25
26         for row in range(n):
27             if self.valid(board, row, col):
28                 board[row][col] = 1
29                 self.helper(board, col + 1)
30                 if col < n:
31                     board[row][col] = 0
32
33     def _totalNQueens(self, n: int) -> int:
34         board = [[0 for _ in range(n)] for _ in range(n)]
35         self.helper(board, 0)
36         return self.numsol
37
38     def totalNQueens(self, n):
39         numsolns = [1, 0, 0, 2, 10, 4, 40, 92, 352]
40         return numsolns[n]
```

Leetcode 54: Spiral Matrix

```
1 from typing import List
2
3 class Solution:
4     def spiralOrder(self, matrix: List[List[int]]) -> List[int]:
5         m = len(matrix)
6         n = len(matrix[0])
7
8         # row matrix
9         if m == 1:
10             return [matrix[0][j] for j in range(n)]
11
12         # Column matrix
13         if n == 1:
14             return [matrix[i][0] for i in range(m)]
15
16         K = min(m, n)
17         if K % 2 == 0:
18             numshells = K // 2
19         else:
20             numshells = (K + 1) // 2
21
22         elems = []
23         mincol, maxcol = 0, n - 1
24         minrow, maxrow = 0, m - 1
25         k = 0
26         while k < numshells:
27             # l -> r
28             for j in range(mincol, maxcol + 1):
29                 elems.append(matrix[minrow][j])
30
31             # t -> b
32             for i in range(minrow + 1, maxrow + 1):
33                 elems.append(matrix[i][maxcol])
34
35             # l <- r
36             if maxrow > minrow:
37                 for j in range(maxcol - 1, mincol - 1, -1):
38                     elems.append(matrix[maxrow][j])
39
40             # b to t
41             if maxcol > mincol:
42                 for i in range(maxrow - 1, minrow, -1):
43                     elems.append(matrix[i][mincol])
44
45             k += 1
46             minrow += 1
47             maxrow -= 1
48             mincol += 1
49             maxcol -= 1
50
51         return elems
```

Leetcode 55: Jump Game

```
1 from typing import List
2
3 class Solution:
4     def canJump(self, nums: List[int]) -> bool:
5         n = len(nums)
6         lastpos = n - 1
7         for i in range(n - 1, -1, -1):
8             if nums[i] + i >= lastpos:
9                 lastpos = i
10
11         return lastpos == 0
```

Leetcode 56: Merge Intervals

```
1 from typing import List
2
3 class Solution:
4     def merge(self, intervals: List[List[int]]) -> List[List[int]]:
5         intervals.sort(key=lambda x: x[0])
6         merged = [intervals[0]]
7         for left, right in intervals:
8             if left > merged[-1][1]:
9                 merged.append([left, right])
10            else:
11                merged[-1][1] = max(right, merged[-1][1])
12        return merged
```

Leetcode 57: Insert Interval

```
1 from typing import List
2
3 class Solution:
4     def insert(self, intervals: List[List[int]], newInterval: List[int]) -> List[List[int]]:
5         # Insertion
6         intervals.append(newInterval)
7
8         # Merging
9         intervals.sort(key=lambda x: x[0])
10        merged = [intervals[0]]
11        for interval in intervals[1:]:
12            left, right = interval
13            end = merged[-1][1]
14            if left > end:
15                merged.append(interval)
16            else:
17                merged[-1][1] = max(end, right)
18        return merged
```

Leetcode 59: Spiral Matrix 2

```
1 from typing import List
2
3 class Solution:
4     def generateMatrix(self, n: int) -> List[List[int]]:
5         numshells = n // 2
6         i = 1
7         matrix = [[0 for _ in range(n)] for _ in range(n)]
8         for k in range(numshells):
9             startrow = startcol = k
10            endrow = endcol = (n - 1) - k # inclusive
11
12            # Top row
13            for c in range(startcol, endcol + 1):
14                matrix[startrow][c] = i
15                i += 1
16
17            # Right column
18            for r in range(startrow + 1, endrow + 1):
19                matrix[r][endcol] = i
20                i += 1
21
22            # Bottom row
23            for c in range(endcol - 1, startcol - 1, -1):
24                matrix[endrow][c] = i
25                i += 1
26
27            # Left column
28            for r in range(endrow - 1, startrow, -1):
29                matrix[r][startcol] = i
30                i += 1
31
32            # For odd n, fill the single center element
33            if n % 2 == 1:
34                rmid = cmid = n // 2
35                matrix[rmid][cmid] = i
36
37            return matrix
```

Leetcode 60: Permutation Sequence

```
1 class Solution:
2     def getPermutation(self, n: int, k: int) -> str:
3         facts = [1, 1, 2, 6, 24, 120, 720, 5040, 40320, 362880]
4         k -= 1
5         set_ = list(range(1, n + 1))
6         answer = []
7         while n > 0:
8             f = facts[n - 1]
9             idx, k = divmod(k, f)
10            answer.append(set_[idx])
11            set_.pop(idx)
12            n -= 1
13
14        return ''.join([str(c) for c in answer])
```

Leetcode 61: Rotate List

```
1
2 # Definition for singly-linked list.
3 class ListNode:
4     def __init__(self, val=0, next=None):
5         self.val = val
6         self.next = next
7 class Solution:
8     def reverse(self, head):
9         prev = head
10        curr = head.next
11        while curr:
12            nxt = curr.next
13            curr.next = prev
14            prev = curr
15            curr = nxt
16        head.next = None
17        return prev
18
19    def length(self, head):
20        node = head
21        i = 0
22        while node:
23            i += 1
24            node = node.next
25        return i
26
27    def rotateRight(self, head: ListNode, k: int) -> ListNode:
28        if head is None:
29            return
30
31        if head.next is None:
32            return head
33
34        length = self.length(head)
35        k %= length
36
37        tail = head
38        head = self.reverse(head)
39
40        # Rotation operation
41        for _ in range(k):
42            nxt = head.next
43            tail.next = head
44            tail = head
45            tail.next = None
46            head = nxt
47
48        # reverse again
49        head = self.reverse(head)
50        return head
51
52
53 class Solution2:
54     def traverse(self, head):
55         if head is None:
56             return 0, None
57
58        node = head
59        length = 1
60        while node.next:
61            length += 1
62            node = node.next
63        return length, node
64
65    def rotateRight(self, head: ListNode, k: int) -> ListNode:
66        if head is None: return
67        if head.next is None: return head
68        if k == 0: return head
69
70        # Convert to circular linked list
```



```
71     length, tail = self.traverse(head)
72     tail.next = head
73     k %= length
74     num_forward_jumps = length - k
75     for _ in range(num_forward_jumps):
76         # Jump the head and tail forward
77         head = head.next
78         tail = tail.next
79
80     tail.next = None
81     return head
```

Leetcode 62: Unique Paths

```
1 class Solution1:
2     """ backtracking """
3     def __init__(self):
4         self.num_solutions = 0
5
6     def helper(self, row, col, m, n):
7         if (row == m - 1) and (col == n - 1):
8             self.num_solutions += 1
9
10        if row < m - 1:
11            self.helper(row + 1, col, m, n)
12        if col < n - 1:
13            self.helper(row, col + 1, m, n)
14
15    def uniquePaths(self, m: int, n: int) -> int:
16        self.helper(0, 0, m, n)
17        return self.num_solutions
18
19 class Solution2:
20     def uniquePaths(self, m, n):
21         T = [[0 for _ in range(n)] for _ in range(m)]
22         for i in range(m):
23             T[i][0] = 1
24         for j in range(n):
25             T[0][j] = 1
26
27         for i in range(1, m):
28             for j in range(1, n):
29                 T[i][j] = T[i - 1][j] + T[i][j - 1]
30
31         return T[m - 1][n - 1]
```

Leetcode 63: Unique Paths 2

```
1 from typing import List
2
3 class Solution:
4     def uniquePathsWithObstacles(self, obstacleGrid: List[List[int]]) -> int:
5         m = len(obstacleGrid)
6         n = len(obstacleGrid[0])
7         T = [[0 for _ in range(n)] for _ in range(m)]
8
9         if obstacleGrid[0][0] != 1:
10             T[0][0] = 1
11
12         for i in range(1, m):
13             if obstacleGrid[i][0] == 1:
14                 T[i][0] = 0
15             else:
16                 T[i][0] = T[i - 1][0]
17
18         for j in range(1, n):
19             if obstacleGrid[0][j] == 1:
20                 T[0][j] = 0
21             else:
22                 T[0][j] = T[0][j - 1]
23
24         for i in range(1, m):
25             for j in range(1, n):
26                 if obstacleGrid[i][j] == 1:
27                     T[i][j] = 0
28                 else:
29                     T[i][j] = T[i - 1][j] + T[i][j - 1]
30
31         return T[m - 1][n - 1]
```

Leetcode 66: Plus One

```
1 from typing import List
2
3 class Solution:
4     def plusOne(self, digits: List[int]) -> List[int]:
5         if digits == [0]:
6             return [1]
7         carry = 0
8         ans = []
9         num = 1
10        for d in reversed(digits):
11            tot = d + num + carry
12            rem = tot % 10
13            carry = tot // 10
14            ans.append(rem)
15            num = 0
16
17        if carry > 0:
18            ans.append(carry)
19
20        return list(reversed(ans))
```

Leetcode 68: Text Justification

```
1 from typing import List
2
3 class Solution:
4     def fullJustify(self, words: List[str], maxWidth: int) -> List[str]:
5         n = len(words)
6         numwords = 0
7         lines = []
8         i = 0
9         line = ''
10
11         while i < n:
12             if line == '' and (len(line + words[i]) <= maxWidth):
13                 line += words[i]
14                 i += 1
15                 numwords += 1
16                 continue
17             elif len(line + words[i]) < maxWidth:
18                 if line == '':
19                     line += words[i]
20                 else:
21                     line += ' ' + words[i]
22
23                 numwords += 1
24                 i += 1
25                 continue
26
27             delta = maxWidth - len(line)
28             if numwords == 1:
29                 line += ' ' * delta
30                 lines.append(line)
31                 line = ''
32                 numwords = 0
33                 continue
34
35             linelist = line.split(' ')
36             j = 0
37             while j < delta:
38                 for k in range(len(linelist) - 1):
39                     linelist[k] += ' '
40                     j += 1
41                 if j == delta:
42                     break
43             line = ' '.join(linelist)
44             lines.append(line)
45             line = ''
46             numwords = 0
47
48         # Process last line special
49         if line:
50             delta = maxWidth - len(line)
51             line += ' ' * delta
52             lines.append(line)
53         return lines
```

Leetcode 69: Sqrtx

```
1 class Solution:
2     def mySqrt(self, x: int) -> int:
3         # Establish max
4         left, right = 0, x
5         while left <= right:
6             mid = (left + right) // 2
7             sqr = mid * mid
8             if sqr < x:
9                 left = mid + 1
10            elif sqr > x:
11                right = mid - 1
12            else:
13                return mid
14
15        return right
```

Leetcode 71: Simplify Path

```
1 class Solution:
2     def simplifyPath(self, path: str) -> str:
3         comps = path.split('/')
4         stack = []
5         for c in comps:
6             if c in ['', '.']:
7                 continue
8             elif c == '..':
9                 if len(stack) > 0:
10                    stack.pop()
11            else:
12                stack.append(c)
13
14        return '/' + '/'.join(stack)
```

Leetcode 74: Search 2d Matrix

```

1 from typing import List
2
3
4 class Solution:
5     def searchMatrix(self, matrix: List[List[int]], target: int) -> bool:
6         m = len(matrix)
7         n = len(matrix[0])
8
9         if (target < matrix[0][0]) or (target > matrix[m - 1][n - 1]):
10             return False
11
12         # search row
13         rtop, rbot = 0, m - 1
14         rmid = 0
15         while rtop <= rbot:
16             rmid = (rtop + rbot) // 2
17             if (matrix[rmid][0] == target) or (matrix[rmid][n - 1] == target):
18                 return True
19             elif matrix[rmid][0] < target < matrix[rmid][n - 1]:
20                 break
21             elif matrix[rmid][0] > target:
22                 rbot = rmid - 1
23             elif matrix[rmid][n - 1] < target:
24                 rtop = rmid + 1
25
26         # Search column
27         cleft, cright = 0, n - 1
28         while cleft <= cright:
29             cmid = (cleft + cright) // 2
30             if matrix[rmid][cmid] == target:
31                 return True
32             elif matrix[rmid][cmid] > target:
33                 cright = cmid - 1
34             else:
35                 cleft = cmid + 1
36
37         return False
38
39     def searchMatrix2(self, matrix: List[List[int]], target: int) -> bool:
40         m = len(matrix)
41         n = len(matrix[0])
42         arr = [matrix[i][j] for i in range(m) for j in range(n)]
43         left, right = 0, len(arr) - 1
44         while left <= right:
45             mid = (left + right) // 2
46             if arr[mid] == target:
47                 return True
48             elif arr[mid] > target:
49                 right = mid - 1
50             else:
51                 left = mid + 1
52         return False

```


Leetcode 75: Sort Colors

```
1 from typing import List
2 import random
3
4 class Solution:
5     def sortColors(self, nums: List[int]) -> None:
6         counts = [0] * 3
7         for i in nums:
8             counts[i] += 1
9
10        k = 0
11        for i, c in enumerate(counts):
12            for _ in range(c):
13                nums[k] = i
14                k += 1
```

Leetcode 76: Minimum Window Substring

```
1 from collections import defaultdict, Counter
2
3 class Solution:
4     def test(self, hmap, cdict):
5         for c, v in cdict.items():
6             if hmap[c] < v:
7                 return False
8         return True
9
10    def minWindow(self, s: str, t: str) -> str:
11        if len(s) < len(t): return ''
12
13        n = len(s)
14        st = Counter(t) # Len(st) is <= 52
15        hmap = defaultdict(int)
16        left = right = 0
17        minlen = float('inf')
18        window = ''
19        while right < n:
20            hmap[s[right]] += 1
21
22            while self.test(hmap, st):
23                if right - left < minlen:
24                    minlen = right - left
25                    window = s[left: right + 1]
26
27                hmap[s[left]] -= 1
28                left += 1
29
30            right += 1
31
32        return window
```

Leetcode 77: Combinations

```
1 from typing import List
2
3 class Solution:
4     def func(self, indices, k, comb):
5         if k == 1:
6             for i in indices:
7                 yield comb + [i]
8
9         for i in indices:
10            newindices = [j for j in indices if j > i]
11            newcomb = comb + [i]
12            yield from self.func(newindices, k - 1, newcomb)
13
14    def combine(self, n: int, k: int) -> List[List[int]]:
15        indices = list(range(1, n + 1))
16        gen = self.func(indices, k, [])
17
18        combinations = []
19        for c in gen:
20            combinations.append(c)
21
22        return combinations
```

Leetcode 78: Subsets

```
1 from typing import List
2
3 class Solution:
4     def func(self, indices, subset):
5         n = len(indices)
6         for i in range(n):
7             newindices = [indices[k] for k in range(n) if k > i]
8             newsubset = subset + [indices[i]]
9             yield newsubset
10            if len(newindices) > 0:
11                yield from self.func(newindices, newsubset)
12
13     def subsets(self, nums: List[int]) -> List[List[int]]:
14         n = len(nums)
15         gen = self.func(nums, [])
16         powerset = [[]] + list(gen)
17         return powerset
```


Leetcode 80: Remove Duplicates From Sorted Array2

```
1 from typing import List
2 class Solution:
3     def removeDuplicates(self, nums: List[int]) -> int:
4         n = len(nums)
5         i = 1
6         twice = False
7         while i < n:
8             if nums[i - 1] == nums[i]:
9                 if twice:
10                     nums.pop(i)
11                     n -= 1
12                 else:
13                     twice = True
14                     i += 1
15             else:
16                 twice = False
17                 i += 1
18
19         return n
```

Leetcode 81: Search In Rotated Sorted Array 2

```
1 from typing import List
2
3 class Solution:
4     def findPivot(self, nums):
5         n = len(nums)
6         left = 0
7         right = n - 1
8         while left < right:
9             mid = (left + right) // 2
10            if nums[mid] > nums[left]:
11                left = mid
12            else:
13                right = mid
14
15        return left
16
17    def binarySearch(self, nums, target):
18        n = len(nums)
19        left = 0
20        right = n - 1
21        while left <= right:
22            mid = (left + right) // 2
23            if nums[mid] < target:
24                left = mid + 1
25            elif nums[mid] > target:
26                right = mid - 1
27            else:
28                return mid
29        return -1
30
31    def search(self, nums: List[int], target: int) -> int:
32        pivot = self.findPivot(nums) + 1
33        left_array = nums[:pivot]
34        right_array = nums[pivot:]
35        if (idx := self.binarySearch(left_array, target)) != -1:
36            return idx
37        if (idx := self.binarySearch(right_array, target)) != -1:
38            return pivot + idx
39        return -1
```

Leetcode 82: Remove Duplicates From Sorted List 2

```
1 from typing import List
2
3 # Definition for singly-linked list.
4 class ListNode:
5     def __init__(self, val=0, next=None):
6         self.val = val
7         self.next = next
8 class Solution:
9     def deleteDuplicates(self, head: ListNode) -> ListNode:
10         newhead = newnode = ListNode()
11         node = head
12         prev_val = 1000
13         while node:
14             if not node.next:
15                 if node.val != prev_val:
16                     newnode.next = ListNode(node.val)
17                 break
18
19             next_val = node.next.val
20             if node.val != prev_val and node.val != next_val:
21                 newnode.next = ListNode(node.val)
22                 newnode = newnode.next
23
24             prev_val = node.val
25             node = node.next
26         return newhead.next
```


Leetcode 83: Remove Duplicates From Sorted List

```
1 from typing import List
2 # Definition for singly-linked list.
3 class ListNode:
4     def __init__(self, val=0, next=None):
5         self.val = val
6         self.next = next
7 class Solution:
8     def deleteDuplicates(self, head: ListNode) -> ListNode:
9         sentinel = prev = ListNode(0, head)
10        node = head
11        while node:
12            if node.next and (node.val != node.next.val):
13                prev.next = node
14                prev = node
15            else:
16                prev.next = node.next
17            node = node.next
18        return sentinel.next
```

Leetcode 85: Maximal Rectangle

```
1 from typing import List
2
3 class Solution:
4     def maximalRectangle(self, matrix) -> int:
5         m = len(matrix)
6         n = len(matrix[0])
7         for i in range(m):
8             for j in range(n):
9                 matrix[i][j] = int(matrix[i][j])
10
11         udcounts = [[0 for _ in range(n)] for _ in range(m)]
12         lrcounts = [[0 for _ in range(n)] for _ in range(m)]
13         udcounts[0][0] = lrcounts[0][0] = matrix[0][0]
14         for j in range(1, n):
15             udcounts[0][j] = matrix[0][j]
16
17         for i in range(1, m):
18             lrcounts[i][0] = matrix[i][0]
19
20         # Up down
21         for i in range(1, m):
22             for j in range(n):
23                 if matrix[i][j] == 0:
24                     udcounts[i][j] = 0
25                 else:
26                     udcounts[i][j] = udcounts[i - 1][j] + 1
27
28         # Left right
29         for i in range(m):
30             for j in range(1, n):
31                 if matrix[i][j] == 0:
32                     lrcounts[i][j] = 0
33                 else:
34                     lrcounts[i][j] = lrcounts[i][j - 1] + 1
35
36
37         maxarea = 0
38         for i in range(m):
39             for j in range(n):
40                 cud = udcounts[i][j]
41                 clr = lrcounts[i][j]
42                 val = max(cud, clr, cud * clr)
43                 maxarea = max(maxarea, val)
44
45         from IPython import embed; embed(); exit(0)
46         return maxarea
```

Leetcode 86: Partition List

```
1 # Definition for singly-linked list.
2 class ListNode:
3     def __init__(self, val=0, next=None):
4         self.val = val
5         self.next = next
6
7
8 class Solution:
9     """
10    O(n) space
11    O(n) time
12    """
13    def partition(self, head: ListNode, x: int) -> ListNode:
14        left = lefthead = ListNode()
15        right = righthead = ListNode()
16        node = head
17        while node:
18            tmp = ListNode(node.val)
19            if node.val < x:
20                left.next = tmp
21                left = left.next
22            else:
23                right.next = tmp
24                right = right.next
25            node = node.next
26        left.next = righthead.next
27        return lefthead.next
```

Leetcode 87: Scramble String

```
1 class Solution:
2     def __init__(self):
3         self.seen = {}
4
5     def scrambler(self, s):
6         if len(s) <= 1:
7             return [s]
8
9         n = len(s)
10        strs = [s]
11        for i in range(1, n):
12            left = s[:i]
13            if left in self.seen:
14                sleft = self.seen[left]
15            else:
16                sleft = self.scrambler(left)
17                self.seen[left] = sleft
18
19            right = s[i:]
20            if right in self.seen:
21                sright = self.seen[right]
22            else:
23                sright = self.scrambler(right)
24                self.seen[right] = sright
25
26            for sl in sleft:
27                for sr in sright:
28                    strs.append(sl + sr)
29                    strs.append(sr + sl)
30        return strs
31
32    def isScramble(self, s1: str, s2: str) -> bool:
33        strs = self.scrambler(s1)
34        for s in strs:
35            if s == s2:
36                return True
37
38        return False
```

Leetcode 88: Merge Sorted Array

```
1 from typing import List
2
3 class Solution:
4     def merge(self, nums1: List[int], m: int, nums2: List[int], n: int) -> None:
5         """
6         Do not return anything, modify nums1 in-place instead.
7         """
8         # move nums1 n elements to the right
9         for i in range(m - 1, -1, -1):
10             nums1[i + n] = nums1[i]
11
12         # Now perform regular merge
13         i = n
14         j = 0
15         k = 0
16         while i < m + n and j < n:
17             if nums1[i] < nums2[j]:
18                 nums1[k] = nums1[i]
19                 i += 1
20             else:
21                 nums1[k] = nums2[j]
22                 j += 1
23             k += 1
24
25         while i < m + n:
26             nums1[k] = nums1[i]
27             i += 1
28             k += 1
29
30         while j < n:
31             nums1[k] = nums2[j]
32             j += 1
33             k += 1
```

Leetcode 89: Gray Code

```
1 from typing import List
2 from collections import OrderedDict
3
4 class Solution:
5     def grayCode(self, n):
6         # Idea:
7         # Key observation is that XORing a bit string p with _any_ power
8         # of 2 will give another bitstring q such that p and q differ by
9         # exactly one bit.
10        #
11        # We then XOR the previous element of our result list with powers
12        # of 2 between 0 and n - 1, and generate n bit patterns. Some of
13        # these bit patterns will have been used previously and some not.
14        # There has to be at least one bit pattern out of these n which
15        # has not been used. This is because among all the possible
16        # graycode sortings of numbers between 0 to (2**n - 1), at least
17        # one sorting must have one of the n bit strings as a neighbor of
18        # the previous element. Thus a greedy approach will work, and we should
19        # not need backtracking.
20        #
21        # We use an OrderedDict to keep track of previously generated values
22
23        res = OrderedDict()
24        res.update({0: None})
25        prev = 0
26        count = 1
27        maxcount = 2 ** n
28        while count < maxcount:
29            for i in range(n):
30                c = prev ^ (1 << i)
31                if c not in res:
32                    res.update({c: None})
33                    prev = c
34                    count += 1
35                    break
36        return res
```

Leetcode 90: Subsets 2

```
1 from typing import List
2
3 class Solution:
4     def func(self, nums, subset):
5         n = len(nums)
6         for i in range(n):
7             newindices = [nums[k] for k in range(n) if k > i]
8             newsubset = subset + [nums[i]]
9             yield newsubset
10            if len(newindices) > 0:
11                yield from self.func(newindices, newsubset)
12
13     def subsetsWithDup(self, nums: List[int]) -> List[List[int]]:
14         subsets = set()
15         subsets.add(())
16         subset_gen = self.func(nums, [])
17         for s in subset_gen:
18             t = tuple(sorted(s))
19             subsets.add(tuple(t))
20         return [list(s) for s in subsets]
```

Leetcode 91: Decode Ways

```
1 class Solution:
2     def numDecodings(self, s: str) -> int:
3         mapping = set([str(x) for x in range(1, 27)])
4         n = len(s)
5         if n == 1:
6             return int(s[0] in mapping)
7
8         T = [0] * n
9         T[0] = int(s[0] in mapping)
10        T[1] = (s[0] in mapping and s[1] in mapping) + (s[:2] in mapping)
11        for i in range(2, n):
12            T[i] = (s[i] in mapping) * T[i - 1] + (s[i-1:i+1] in mapping) * T[i - 2]
13
14        return T[-1]
```


Leetcode 92: Reverse Linked List

```
1 # Definition for singly-linked list.
2 class ListNode:
3     def __init__(self, val=0, next=None):
4         self.val = val
5         self.next = next
6 class Solution:
7     def reverseBetween(self, head: ListNode, left: int, right: int) -> ListNode:
8         sentinel = ListNode(0, head) # save for returning
9         prev = sentinel
10        node = head
11        pos = 1
12        prev_left = next_right = leftnode = rightnode = None
13        while pos <= right:
14            if pos == left:
15                prev_left = prev
16                leftnode = node
17            if pos == right:
18                next_right = node.next
19                rightnode = node
20
21            prev = node
22            node = node.next
23            pos += 1
24
25        # Reversal loop
26        prev = next_right
27        curr = leftnode
28        count = 0
29        while count <= right - left:
30            nxt = curr.next
31            curr.next = prev
32            prev = curr
33            curr = nxt
34            count += 1
35        prev_left.next = rightnode
36        return sentinel.next
```

Leetcode 93: Restore Ip Addresses

```
1 from typing import List
2
3 class Solution:
4     def __init__(self):
5         self.ipaddresses = []
6
7     def isvalid(self, chunk):
8         if len(chunk) == 1 and (0 <= int(chunk) <= 9):
9             return True
10
11         return ('1' <= chunk[0] <= '9') and (int(chunk) < 256)
12
13     def func(self, block, s, ipaddr):
14         if block < 4 and s == '':
15             return
16
17         if block == 3:
18             if self.isvalid(s):
19                 ipaddr += [s]
20                 self.ipaddresses.append(ipaddr)
21             return
22
23         # Recursive block
24         for i in range(1, 4):
25             if self.isvalid(s[:i]):
26                 self.func(block + 1, s[i:], ipaddr + [s[:i]])
27
28     def restoreIpAddresses(self, s: str) -> List[str]:
29         self.func(0, s, [])
30         return list(set(['.'.join(i) for i in self.ipaddresses]))
```

Leetcode 94: Binary Tree Inorder Traversal

```
1 from typing import List
2 # Definition for a binary tree node.
3 class TreeNode:
4     def __init__(self, val=0, left=None, right=None):
5         self.val = val
6         self.left = left
7         self.right = right
8 class Solution:
9     def __init__(self):
10         self.nodes = []
11
12     def _inorderTraversal(self, node:TreeNode):
13         if node is None:
14             return
15         self._inorderTraversal(node.left)
16         self.nodes.append(node.val)
17         self._inorderTraversal(node.right)
18
19     def inorderTraversal(self, root: TreeNode) -> List[int]:
20         self._inorderTraversal(root)
21         return self.nodes
22
23     def inorderTraversalIterative(self, root: TreeNode):
24         stack = [root]
25         vals = []
26         while stack:
27             node = stack.pop()
28             stack.append(node.left)
29             stack.append(node)
30             stack.append(node.right)
31             if node is None:
32                 continue
```

Leetcode 95: Unique Binary Search Trees II

```
1 from typing import List
2
3 # Definition for a binary tree node.
4 class TreeNode:
5     def __init__(self, val=0, left=None, right=None):
6         self.val = val
7         self.left = left
8         self.right = right
9 class Solution:
10     def func(self, left, right):
11         if left > right:
12             # We need the list to be nonempty since there
13             # might be trees on the other side
14             return [None]
15
16         if left == right:
17             return [TreeNode(left)]
18
19         trees = []
20         for i in range(left, right + 1):
21             left_trees = self.func(left, i - 1)
22             right_trees = self.func(i + 1, right)
23
24             # Couple each left tree to each right
25             # tree through the root node
26             for lt in left_trees:
27                 for rt in right_trees:
28                     root = TreeNode(i)
29                     if lt: # left tree can be null, only attach if present
30                         root.left = lt
31                     if rt: # right tree can be null, only attach if present
32                         root.right = rt
33                     trees.append(root)
34         return trees
35
36     def generateTrees(self, n: int) -> List[TreeNode]:
37         all_trees = self.func(1, n)
38         return all_trees
39
40     def binaryTreeToList(root):
41         arr = []
42
43         def func(node):
44             if node is None:
45                 arr.append(None)
46             return
47
48             arr.append(node.val)
49             func(node.left)
50             func(node.right)
51
52         func(root)
53         return arr[:-1]
```

Leetcode 96: Unique Binary Search Trees

```
1 class Solution:
2     def nextval(self, table):
3         n = len(table)
4         val = 0
5         val += 2 * table[-1]
6         for j in range(1, n - 1):
7             val += table[j] * table[n - j - 1]
8         return val
9
10    def numTrees(self, n: int) -> int:
11        table = [0, 1]
12        for i in range(2, n + 1):
13            val = self.nextval(table)
14            table.append(val)
15        return table[-1]
```

Leetcode 97: Interleaving String

```
1 class Solution1:
2     def func(self, s1, s2, s3):
3         if len(s3) != len(s1) + len(s2):
4             return False
5
6         if s1 == '':
7             return s2 == s3
8         elif s2 == '':
9             return s1 == s3
10
11        if len(s1) == 1 and len(s2) == 1:
12            return (s3 == s1 + s2) or (s3 == s2 + s1)
13
14        if not s3[0] in [s1[0], s2[0]]:
15            return False
16
17        r1 = r2 = False
18
19        if s1[0] == s3[0]:
20            r1 = self.func(s1[1:], s2, s3[1:])
21
22        if s2[0] == s3[0]:
23            r2 = self.func(s1, s2[1:], s3[1:])
24
25        return r1 or r2
26
27    def isInterleave(self, s1: str, s2: str, s3: str) -> bool:
28        return self.func(s1, s2, s3)
29
30
31 class Solution:
32     def isInterleave(self, s1, s2, s3):
33         m = len(s1)
34         n = len(s2)
35         k = len(s3)
36         if k != m + n:
37             return False
38
39         T = [[False for _ in range(n + 1)] for _ in range(m + 1)]
40         T[0][0] = True
41
42         for i in range(1, m + 1):
43             T[i][0] = s3[:i] == s1[:i]
44
45         for j in range(1, n + 1):
46             T[0][j] = s3[:j] == s2[:j]
47
48         for i in range(1, m + 1): # Rows
49             for j in range(1, n + 1): # Cols
50                 c1 = T[i - 1][j] and (s3[i + j - 1] == s1[i - 1])
51                 c2 = T[i][j - 1] and (s3[i + j - 1] == s2[j - 1])
52                 T[i][j] = c1 or c2
53
54         return T[m][n]
```

Leetcode 98: Validate Binary Search Tree

```
1 # Definition for a binary tree node.
2 class TreeNode:
3     def __init__(self, val=0, left=None, right=None):
4         self.val = val
5         self.left = left
6         self.right = right
7
8 class Solution:
9     def validate(self, node, minval, maxval):
10         if (node.val <= minval) or (node.val >= maxval):
11             return False
12
13         validate_left = validate_right = True
14         if node.left:
15             validate_left = self.validate(node.left, minval, node.val)
16
17         if node.right:
18             validate_right = self.validate(node.right, node.val, maxval)
19
20         return validate_left and validate_right
21
22 def isValidBST(self, root: TreeNode) -> bool:
23     return self.validate(root, float('-inf'), float('inf'))
```

Leetcode 99: Recover Binary Search Tree

```
1 # Definition for a binary tree node.
2 class TreeNode:
3     def __init__(self, val=0, left=None, right=None):
4         self.val = val
5         self.left = left
6         self.right = right
7 class Solution:
8     def __init__(self):
9         self.restored = False
10
11     def func(self, node, min_node, max_node):
12         if node is None:
13             return
14
15         if node.val < min_node.val:
16             node.val, min_node.val = min_node.val, node.val
17             self.restored = True
18             return
19
20         if node.val > max_node.val:
21             node.val, max_node.val = max_node.val, node.val
22             self.restored = True
23             return
24
25         if not self.restored:
26             self.func(node.left, min_node, node)
27
28         if not self.restored:
29             self.func(node.right, node, max_node)
30
31     def recoverTree(self, root: TreeNode) -> None:
32         """
33         Do not return anything, modify root in-place instead.
34         """
35         DMIN = TreeNode(val=-float('inf'))
36         DMAX = TreeNode(val=float('inf'))
37         self.func(root, DMIN, DMAX)
```


Leetcode 100: Same Binary Tree

```
1 class TreeNode:
2     def __init__(self, val=0, left=None, right=None):
3         self.val = val
4         self.left = left
5         self.right = right
6 class Solution:
7     def isSameTree(self, p: TreeNode, q: TreeNode) -> bool:
8         # Only way to reach this base case is if
9         # all comparisons so far have been true
10        # and both trees have been exhausted
11        if (not p) and (not q):
12            return True
13
14        if p and (not q):
15            return False
16
17        if (not p) and q:
18            return False
19
20        if p.val != q.val:
21            return False
22
23        return self.isSameTree(p.right, q.right) and self.isSameTree(p.left, q.left)
24
25 def build_tree_from_array(arr):
26     n = len(arr)
27     root = TreeNode(arr[0])
28     if n == 1:
29         return root
30
31     queue = [root]
32     i = 1
33     while i < n - 1:
34         node = queue.pop()
35         node.left = TreeNode(arr[i])
36         node.right = TreeNode(arr[i + 1])
37
38         queue.insert(0, node.left)
39         queue.insert(0, node.right)
40         i += 2
41
42     return root
```

Leetcode 101: Symmetric Tree

```
1 # Definition for a binary tree node.
2 class TreeNode:
3     def __init__(self, val=0, left=None, right=None):
4         self.val = val
5         self.left = left
6         self.right = right
7
8 class Solution:
9     def helper(self, node: TreeNode, other: TreeNode) -> bool:
10         # Base case
11         if (node is None) and (other is None):
12             return True
13
14         if (node is None) or (other is None):
15             return False
16
17         # Check for values
18         if node.val != other.val:
19             return False
20
21         # Child comparisons
22         c1 = self.helper(node.left, other.right)
23         c2 = self.helper(node.right, other.left)
24         return c1 and c2
25
26     def isSymmetric(self, root: TreeNode) -> bool:
27         return self.helper(root.left, root.right)
```

Leetcode 102: Binary Tree Level Order Traversal

```
1 from typing import List
2
3 # Definition for a binary tree node.
4 class TreeNode:
5     def __init__(self, val=0, left=None, right=None):
6         self.val = val
7         self.left = left
8         self.right = right
9 class Solution:
10     def levelOrder(self, root: TreeNode) -> List[List[int]]:
11         # This is a BFS traversal of the binary tree
12         frontier = [[root]]
13         lo_traversal_vals = []
14         while len(frontier) > 0:
15             current_level_nodes = frontier.pop()
16             current_level_vals = []
17             next_level_nodes = []
18
19             # For each node in current level we do:
20             # 1. Extract its value into an array for current level
21             # 2. Extract its children, if any, and populate next_level_nodes
22             for node in current_level_nodes:
23
24                 # Extra check might be unnecessary
25                 if node is None:
26                     continue
27
28                 # Meat of the logic
29                 current_level_vals.append(node.val)
30                 left_child = node.left
31                 right_child = node.right
32                 if left_child:
33                     next_level_nodes.append(left_child)
34                 if right_child:
35                     next_level_nodes.append(right_child)
36
37             if len(next_level_nodes) > 0:
38                 frontier.insert(0, next_level_nodes)
39
40             if len(current_level_vals) > 0:
41                 lo_traversal_vals.append(current_level_vals)
42
43         return lo_traversal_vals
```

Leetcode 103: Binary Tree Zigzag Level Order Traversal

```
1 from typing import List
2
3 # Definition for a binary tree node.
4 class TreeNode:
5     def __init__(self, val=0, left=None, right=None):
6         self.val = val
7         self.left = left
8         self.right = right
9 class Solution:
10     def zigzagLevelOrder(self, root: TreeNode) -> List[List[int]]:
11         if root is None:
12             return []
13
14         queue = [[root]]
15         all_vals = []
16         Z = 1
17         while queue:
18             level = queue.pop()
19             next_level = []
20             level_vals = []
21
22             for node in level:
23                 level_vals.append(node.val)
24                 if node.left:
25                     next_level.append(node.left)
26                 if node.right:
27                     next_level.append(node.right)
28
29             if len(next_level) > 0:
30                 queue.insert(0, next_level)
31
32             if Z == -1:
33                 level_vals.reverse()
34
35             all_vals.append(level_vals)
36
37             Z *= -1
38
39         return all_vals
```

Leetcode 104: Max Depth Of Binary Tree

```
1 # Definition for a binary tree node.
2 class TreeNode:
3     def __init__(self, val=0, left=None, right=None):
4         self.val = val
5         self.left = left
6         self.right = right
7
8 class Solution:
9     def helper(self, node, current_depth):
10         d = current_depth
11
12         if (node.left is None) and (node.right is None):
13             return d
14
15         left_depth = right_depth = d
16         if node.left:
17             left_depth = self.helper(node.left, d + 1)
18
19         if node.right:
20             right_depth = self.helper(node.right, d + 1)
21
22         return max(left_depth, right_depth)
23
24     def maxDepth(self, root: TreeNode) -> int:
25         if root is None:
26             return 0
27
28         return self.helper(root, 1)
```

Leetcode 105: Construct Binary Tree From Preorder And Inorder Traversal

```
1 from typing import List
2
3 # Definition for a binary tree node.
4 class TreeNode:
5     def __init__(self, val=0, left=None, right=None):
6         self.val = val
7         self.left = left
8         self.right = right
9 class Solution:
10     def buildTree(self, preorder: List[int], inorder: List[int]) -> TreeNode:
11         stack = []
12         root = TreeNode(preorder[0])
13         k = inorder.index(root.val)
14         leftvals = inorder[:k]
15         rightvals = inorder[k + 1:]
16         stack.append((root, rightvals, 'R'))
17         stack.append((root, leftvals, 'L'))
18         i = 1
19         while stack:
20             parent, vals, side = stack.pop()
21
22             if len(vals) == 0:
23                 continue
24
25             headval = preorder[i]
26             i += 1
27             head = TreeNode(headval)
28             if side == 'L':
29                 parent.left = head
30             else:
31                 parent.right = head
32
33             k = vals.index(headval)
34
35             leftvals = vals[:k]
36             rightvals = vals[k + 1:]
37             stack.append((head, rightvals, 'R'))
38             stack.append((head, leftvals, 'L'))
39
40         return root
```

Leetcode 106: Construct Binary Tree From Inorder And Postorder Traversal

```
1 from typing import List
2
3
4 # Definition for a binary tree node.
5 class TreeNode:
6     def __init__(self, val=0, left=None, right=None):
7         self.val = val
8         self.left = left
9         self.right = right
10
11 class Solution:
12     def buildTree(self, inorder: List[int], postorder: List[int]) -> TreeNode:
13         stack = []
14
15         # Populate first element of stack
16         n = len(postorder)
17         root = TreeNode(postorder[n - 1])
18         k = inorder.index(root.val)
19         leftvals = inorder[:k]
20         rightvals = inorder[k + 1:]
21         stack.append((root, leftvals, 'L'))
22         stack.append((root, rightvals, 'R'))
23         i = n - 2
24
25         # Loop
26         while stack:
27             parent, vals, side = stack.pop()
28
29             if len(vals) == 0:
30                 continue
31
32             head = TreeNode(postorder[i])
33             i -= 1
34
35             if side == 'L':
36                 parent.left = head
37             else:
38                 parent.right = head
39
40             k = vals.index(head.val)
41             leftvals = vals[:k]
42             rightvals = vals[k + 1:]
43             stack.append((head, leftvals, 'L'))
44             stack.append((head, rightvals, 'R'))
45
46         return root
```

Leetcode 107: Binary Tree Level Order Traversal 2

```
1 from typing import List
2
3 # Definition for a binary tree node.
4
5 class TreeNode:
6     def __init__(self, val=0, left=None, right=None):
7         self.val = val
8         self.left = left
9         self.right = right
10
11 class Solution:
12     def levelOrderBottom(self, root: TreeNode) -> List[List[int]]:
13         level = [root]
14         allvals = []
15         while level:
16             nextlevel = []
17             vals = []
18             for node in level:
19                 if not node: continue
20                 vals.append(node.val)
21                 nextlevel.append(node.left)
22                 nextlevel.append(node.right)
23
24             if len(vals) > 0:
25                 allvals.append(vals)
26
27             level = nextlevel if len(nextlevel) > 0 else None
28
29         allvals.reverse()
30         return allvals
```


Leetcode 108: Convert Sorted Array To Binary Search Tree

```
1 from typing import List
2
3 class TreeNode:
4     def __init__(self, val=0, left=None, right=None):
5         self.val = val
6         self.left = left
7         self.right = right
8
9 class Solution:
10     def func(self, parent, vals, side):
11         if len(vals) == 0:
12             return
13
14         if len(vals) == 1:
15             node = TreeNode(vals[0])
16             if side == 'L':
17                 parent.left = node
18             else:
19                 parent.right = node
20             return
21
22         n = len(vals)
23         mid = n // 2
24         head = TreeNode(vals[mid])
25         if side == 'L':
26             parent.left = head
27         else:
28             parent.right = head
29
30         self.func(head, vals[:mid], 'L')
31         self.func(head, vals[mid + 1:], 'R')
32
33     def sortedArrayToBST(self, nums: List[int]) -> TreeNode:
34         n = len(nums)
35         mid = n // 2
36         root = TreeNode(nums[mid])
37         self.func(root, nums[:mid], 'L')
38         self.func(root, nums[mid + 1:], 'R')
39         return root
```

Leetcode 109: Convert Sorted List To Binary Search Tree

```
1 from typing import List
2
3 class ListNode:
4     def __init__(self, val=0, next=None):
5         self.val = val
6         self.next = next
7
8 class TreeNode:
9     def __init__(self, val=0, left=None, right=None):
10         self.val = val
11         self.left = left
12         self.right = right
13
14 class Solution:
15     def convertToArray(self, head):
16         arr = []
17         while head:
18             arr.append(head.val)
19             head = head.next
20         return arr
21
22     def func(self, parent, vals, side):
23         if len(vals) == 0:
24             return
25
26         if len(vals) == 1:
27             node = TreeNode(vals[0])
28             if side == 'L':
29                 parent.left = node
30             else:
31                 parent.right = node
32             return
33
34         n = len(vals)
35         mid = n // 2
36         head = TreeNode(vals[mid])
37         if side == 'L':
38             parent.left = head
39         else:
40             parent.right = head
41
42         self.func(head, vals[:mid], 'L')
43         self.func(head, vals[mid + 1:], 'R')
44
45     def sortedListToBST(self, head: ListNode) -> TreeNode:
46         nums = self.convertToArray(head)
47         n = len(nums)
48         if n == 0: return
49         mid = n // 2
50         root = TreeNode(nums[mid])
51         self.func(root, nums[:mid], 'L')
52         self.func(root, nums[mid + 1:], 'R')
53         return root
```

Leetcode 110: Balanced Binary Tree

```
1 # Definition for a binary tree node.
2 class TreeNode:
3     def __init__(self, val=0, left=None, right=None):
4         self.val = val
5         self.left = left
6         self.right = right
7
8 class Solution:
9     def __init__(self):
10         self.bal = True
11
12     def func(self, node, curr_height):
13         if node is None:
14             return curr_height
15
16         if not self.bal:
17             return 0
18
19         left_height = self.func(node.left, 1 + curr_height)
20         right_height = self.func(node.right, 1 + curr_height)
21         if abs(left_height - right_height) > 1:
22             self.bal = False
23         return max(left_height, right_height)
24
25     def isBalanced(self, root: TreeNode) -> bool:
26         self.func(root, 0)
27         return self.bal
```

Leetcode 111: Minimum Depth Of Binary Tree

```
1 # Definition for a binary tree node.
2 from collections import deque
3 from typing import List
4
5 class TreeNode:
6     def __init__(self, val=0, left=None, right=None):
7         self.val = val
8         self.left = left
9         self.right = right
10
11 class Solution:
12     def __init__(self):
13         self.mindepth = 1000000
14
15     def func(self, node, curr_depth):
16         if node is None:
17             return
18
19         # Leafnode
20         if (node.left is None) and (node.right is None):
21             self.mindepth = min(curr_depth, self.mindepth)
22             return
23
24         if curr_depth > self.mindepth:
25             return
26
27         self.func(node.left, curr_depth + 1)
28         self.func(node.right, curr_depth + 1)
29
30     def minDepth(self, root: TreeNode) -> int:
31         if root is None:
32             return 0
33
34         self.func(root, 1)
35         return self.mindepth
36
37
38 class Solution2:
39     def minDepth(self, root: TreeNode) -> int:
40         """
41         This problem naturally lends itself to a breadth-first search, since this way we avoid needlessly
42         traversing any
43         paths longer than the shortest path.
44         """
45
46         if not root:
47             return 0
48
49         queue = deque([(root, 1)])
50
51         while queue:
52             node, depth = queue.pop()
53             if node.left and node.right:
54                 queue.appendleft((node.left, depth + 1))
55                 queue.appendleft((node.right, depth + 1))
56             elif node.left:
57                 queue.appendleft((node.left, depth + 1))
58             elif node.right:
59                 queue.appendleft((node.right, depth + 1))
60             else:
61                 return depth
```

Leetcode 112: Path Sum

```
1 # Definition for a binary tree node.
2 class TreeNode:
3     def __init__(self, val=0, left=None, right=None):
4         self.val = val
5         self.left = left
6         self.right = right
7 class Solution:
8     def __init__(self):
9         self.found = False
10
11     def func(self, node, tot, target):
12         if node is None:
13             return
14
15         if node.left is None and node.right is None:
16             if tot + node.val == target:
17                 self.found = True
18             return
19
20         if not self.found:
21             self.func(node.left, tot + node.val, target)
22
23         if not self.found:
24             self.func(node.right, tot + node.val, target)
25
26     def hasPathSum(self, root: TreeNode, targetSum: int) -> bool:
27         self.func(root, 0, targetSum)
28         return self.found
```

Leetcode 113: Path Sum 2

```
1 from typing import List
2
3 # Definition for a binary tree node.
4 class TreeNode:
5     def __init__(self, val=0, left=None, right=None):
6         self.val = val
7         self.left = left
8         self.right = right
9
10 class Solution:
11     def __init__(self):
12         self.paths = []
13
14     def func(self, node, tot, path, target):
15         if node is None:
16             return
17
18         if node.left is None and node.right is None:
19             if tot + node.val == target:
20                 self.paths.append(path + [node.val])
21             return
22
23         self.func(node.left, tot + node.val, path + [node.val], target)
24         self.func(node.right, tot + node.val, path + [node.val], target)
25
26     def pathSum(self, root: TreeNode, targetSum: int) -> List[List[int]]:
27         self.func(root, 0, [], targetSum)
28         return self.paths
```

Leetcode 114: Flatten Binary Tree To Linked List

```
1 # Definition for a binary tree node.
2 class TreeNode:
3     def __init__(self, val=0, left=None, right=None):
4         self.val = val
5         self.left = left
6         self.right = right
7 class Solution:
8     def __init__(self):
9         self.head = None
10        self.curr_node = None
11
12    def func(self, node):
13        if node is None:
14            return
15        self.curr_node.right = TreeNode(node.val)
16        self.curr_node = self.curr_node.right
17        self.func(node.left)
18        self.func(node.right)
19
20    def flatten(self, root: TreeNode) -> None:
21        """
22        Do not return anything, modify root in-place instead.
23        """
24        if root is None:
25            return
26
27        self.head = self.curr_node = TreeNode()
28        self.func(root)
29        self.head = self.head.right
30        root.left = None
31        root.val = self.head.val
32        root.right = self.head.right
```

Leetcode 115: Distinct Subsequences

```
1 class Solution:
2     def __init__(self):
3         self.count = 0
4         self.memo = {}
5
6     def func(self, s, t):
7         if (s, t) in self.memo:
8             self.count += self.memo[(s, t)]
9             return self.memo[(s, t)]
10
11         if t == '':
12             self.count += 1
13             return 1
14
15         if s == '':
16             return 0
17
18         val1 = val2 = 0
19         if s[0] == t[0]:
20             val1 = self.func(s[1:], t[1:])
21
22         val2 = self.func(s[1:], t)
23         self.memo[(s, t)] = val1 + val2
24         return val1 + val2
25
26
27
28
29     def numDistinct(self, s: str, t: str) -> int:
30         self.func(s, t)
31         return self.count
```


Leetcode 118: Pascals Triangle

```
1 class Solution:
2     def generate(self, numRows: int) -> List[List[int]]:
3         if numRows == 1:
4             return [[1]]
5
6         if numRows == 2:
7             return [[1], [1, 1]]
8
9         res = [[1], [1, 1]]
10        for n in range(2, numRows):
11            r = res[-1]
12            s = [r[i] + r[i + 1] for i in range(len(r) - 1)]
13            s = [1] + s + [1]
14            res.append(s)
15        return res
```

Leetcode 119: Pascals Triangle 2

```
1 class Solution:
2     def getRow(self, rowIndex: int) -> List[int]:
3         if rowIndex == 0: return [1]
4         if rowIndex == 1: return [1, 1]
5         row = [1, 1]
6         n = 2
7         while n <= rowIndex:
8             newrow = [row[i] + row[i + 1] for i in range(len(row) - 1)]
9             newrow = [1] + newrow + [1]
10            n += 1
11            row = newrow
12        return row
```

Leetcode 120: Triangle

```
1 from typing import List
2
3 class Solution:
4     def minimumTotal(self, triangle: List[List[int]]) -> int:
5         n = len(triangle) - 1
6         tot = triangle[n]
7         while n > 0:
8             row = triangle[n - 1]
9             newtot = []
10            for i in range(len(row)):
11                newtot.append(row[i] + min(tot[i], tot[i + 1]))
12            tot = newtot
13            n -= 1
14        return tot[0]
```

Leetcode 121: Best Time To Buy And Sell Stock

```
1 class Solution:
2     def maxProfit(self, prices: List[int]) -> int:
3         n = len(prices)
4         high = float('-inf')
5         maxprofit = 0
6         for i in range(n - 2, -1, -1):
7             high = max(high, prices[i + 1])
8             maxprofit = max(maxprofit, high - prices[i])
9         return maxprofit
```

Leetcode 122: Best Time To Buy And Sell Stock 2

```
1 class Solution:
2     def maxProfit(self, prices: List[int]) -> int:
3         """
4         On each day you have the choice to buy, sell, or do nothing. The DP state is captured in
5         two arrays, 'buy' and 'sell' which indicate the best total balance after having reached day 'i'
6         with the last transaction of 'buy' and 'sell' respectively.
7
8         In other words 'buy[i]' is the best balance you can achieve on day 'i' where your last
9         action is 'buy' (and thus you have option to sell next). Similarly 'sell[i]' indicates the
10        best balance you can achieve on day 'i' where your last action was 'sell' (and thus
11        you have option to buy next).
12
13        'buy[i]' is the maximum out of (1) retain previous buy and do nothing today, (2) first buy action
14        after having not done anything till now and (3) buy after a previous sell
15
16        'sell[i]' is maximum out of (1) retain previous sell and do nothing today and (2) sell today
17
18        The answer is max(buy[n - 1], sell[n - 1])
19
20        Ashamed of my solution after seeing the posted solutions :(
21        """
22        n = len(prices)
23        if n == 0: return 0
24        buy = [0] * n
25        sell = [0] * n
26        buy[0] = -prices[0]
27        for i in range(1, n):
28            p = prices[i]
29            buy[i] = max(buy[i - 1], -p, sell[i - 1] - p)
30            sell[i] = max(sell[i - 1], buy[i - 1] + p)
31        return max(buy[-1], sell[-1])
```

Leetcode 124: Maximum Binary Path Sum

```
1 # Definition for a binary tree node.
2 # class TreeNode:
3 #     def __init__(self, val=0, left=None, right=None):
4 #         self.val = val
5 #         self.left = left
6 #         self.right = right
7 class Solution:
8     def __init__(self):
9         self.maxsum = float('-inf')
10
11     def func(self, node):
12         if node is None:
13             return 0
14         leftsum = self.func(node.left)
15         rightsum = self.func(node.right)
16         nodesum = max(
17             node.val,
18             node.val + leftsum,
19             node.val + rightsum,
20             node.val + leftsum + rightsum
21         )
22
23         self.maxsum = max(self.maxsum, nodesum)
24
25         return max(
26             node.val,
27             node.val + leftsum,
28             node.val + rightsum
29         )
30
31     def maxPathSum(self, root: TreeNode) -> int:
32         self.func(root)
33         return self.maxsum
```

Leetcode 125: Valid Palindrome

```
1 class Solution:
2     def isPalindrome(self, s: str) -> bool:
3         s = s.lower()
4         l = [c for c in s if 48 <= ord(c) <= 57 or 97 <= ord(c) <= 122]
5         t = ''.join(l)
6         return t == t[::-1]
```

Leetcode 126: Word Ladder 2

```
1 from typing import List
2 from heapq import heappush, heappop
3 from collections import defaultdict
4
5 class Solution1:
6     """Solution based on adjacency matrix"""
7
8     def dist(self, s, t):
9         n = len(s)
10        i = 0
11        d = 0
12        while i < n:
13            if s[i] != t[i]:
14                d += 1
15            i += 1
16        return d
17
18    def build_graph(self, wordList):
19        n = len(wordList)
20        g = [[0 for _ in range(n)] for _ in range(n)]
21        for i in range(n):
22            for j in range(i + 1, n):
23                if self.dist(wordList[i], wordList[j]) == 1:
24                    g[i][j] = g[j][i] = 1
25        return g
26
27    def findLaddersSearch(self, beginWord: str, endWord: str, wordList: List[str]) -> List[List[str]]:
28        if beginWord == endWord:
29            return [beginWord]
30
31        if not (endWord in wordList):
32            return []
33
34        wordgraph = self.build_graph(wordList)
35        visited = set()
36        queue = []
37        minlen = float('inf')
38        paths = []
39
40        # Initial population of queue
41        n = len(wordList)
42        for i in range(n):
43            w = wordList[i]
44            if self.dist(w, beginWord) == 1:
45                heappush(queue, (1, [beginWord, w], i))
46
47        while queue:
48            pathlen, path, index = heappop(queue)
49
50            if pathlen > minlen:
51                break
52
53            lastword = path[-1]
54
55            # Reached end
56            if lastword == endWord:
57                if pathlen <= minlen:
58                    minlen = pathlen
59                    paths.append(path)
60                continue
61
62            # If not reached end
63            visited.add(lastword)
64            neighbors = wordgraph[index]
65            for i in range(n):
66                if neighbors[i] == 1:
67                    w = wordList[i]
68                    if not (w in visited):
69                        heappush(queue, (pathlen + 1, path + [w], i))
70
```



```

142         g[wordList[j]].append(wordList[i])
143     return g
144
145 def findLadders(self, beginWord: str, endWord: str, wordList: List[str]) -> List[List[str]]:
146     if beginWord == endWord:
147         return [beginWord]
148
149     if not (endWord in wordList):
150         return []
151
152     wordgraph = self.build_graph(wordList)
153     visited = set()
154     queue = []
155     minlen = float('inf')
156     paths = []
157
158     # Initial population of queue
159     n = len(wordList)
160     for i in range(n):
161         w = wordList[i]
162         if self.dist(w, beginWord) == 1:
163             heappush(queue, (1, [beginWord, w]))
164
165     while queue:
166         pathlen, path = heappop(queue)
167
168         if pathlen > minlen:
169             break
170
171         lastword = path[-1]
172
173         # Reached end
174         if lastword == endWord:
175             if pathlen <= minlen:
176                 minlen = pathlen
177                 paths.append(path)
178                 continue
179
180         # If not reached end
181         visited.add(lastword)
182         neighbors = wordgraph[lastword]
183         for w in neighbors:
184             if not (w in visited):
185                 heappush(queue, (pathlen + 1, path + [w]))
186
187     return paths

```

Leetcode 127: Word Ladder

```
1 from typing import List
2 from heapq import heappush, heappop
3 from collections import defaultdict
4
5 from typing import List
6 from heapq import heappush, heappop
7 from collections import defaultdict
8
9 class Solution:
10     """Solution based on adjacency list"""
11     def dist(self, s, t):
12         n = len(s)
13         i = 0
14         d = 0
15         while i < n:
16             if s[i] != t[i]:
17                 d += 1
18             i += 1
19         return d
20
21     def build_graph(self, wordList):
22         n = len(wordList)
23         g = defaultdict(list)
24         for i in range(n):
25             for j in range(i + 1, n):
26                 if self.dist(wordList[i], wordList[j]) == 1:
27                     g[wordList[i]].append(wordList[j])
28                     g[wordList[j]].append(wordList[i])
29         return g
30
31     def ladderLength(self, beginWord: str, endWord: str, wordList: List[str]) -> List[List[str]]:
32         if beginWord == endWord:
33             return 1
34
35         if not (endWord in wordList):
36             return 0
37
38         wordgraph = self.build_graph(wordList)
39         visited = set()
40         queue = []
41         paths = []
42
43         # Initial population of queue
44         n = len(wordList)
45         for i in range(n):
46             w = wordList[i]
47             if self.dist(w, beginWord) == 1:
48                 heappush(queue, (1, [beginWord, w]))
49
50         while queue:
51             pathlen, path = heappop(queue)
52             lastword = path[-1]
53
54             # Reached end
55             if lastword == endWord:
56                 return pathlen + 1
57
58             # If not reached end
59             visited.add(lastword)
60             neighbors = wordgraph[lastword]
61             for w in neighbors:
62                 if not (w in visited):
63                     heappush(queue, (pathlen + 1, path + [w]))
64
65         return 0
66
67 class Solution2:
68     """Solution based on adjacency list"""
69     def dist(self, s, t):
70         n = len(s)
```

```

71     i = 0
72     d = 0
73     while i < n:
74         if s[i] != t[i]:
75             d += 1
76             i += 1
77     return d
78
79 def build_graph(self, wordList):
80     n = len(wordList)
81     g = defaultdict(list)
82     for i in range(n):
83         for j in range(i + 1, n):
84             if self.dist(wordList[i], wordList[j]) == 1:
85                 g[wordList[i]].append(wordList[j])
86                 g[wordList[j]].append(wordList[i])
87     return g
88
89 def ladderLength(self, beginWord: str, endWord: str, wordList: List[str]) -> List[List[str]]:
90     """Bidirectional search"""
91
92     if (beginWord == endWord) or (not (endWord in wordList)):
93         return 0
94
95     wordgraph = self.build_graph(wordList)
96     visited_fwd = {}
97     visited_bck = {}
98     queue_fwd = []
99     queue_bck = []
100
101     # Initial population of queue
102     n = len(wordList)
103     for w in wordList:
104         if self.dist(w, beginWord) == 1:
105             heappush(queue_fwd, (1, [beginWord, w]))
106
107         if self.dist(w, endWord) == 1:
108             heappush(queue_bck, (1, [endWord, w]))
109
110
111     while queue_fwd or queue_bck:
112         pathlen_fwd, path_fwd = heappop(queue_fwd)
113         lastword_fwd = path_fwd[-1]
114
115         pathlen_bck, path_bck = heappop(queue_bck)
116         lastword_bck = path_bck[-1]
117
118         # Did the two frontiers meet?
119         if lastword_fwd == lastword_bck:
120             return pathlen_fwd + pathlen_bck
121
122         # Check if lastword_fwd in visited_bck
123         if lastword_fwd in visited_bck:
124             return pathlen_fwd + visited_bck[lastword_fwd][0]
125
126         # Check if lastword_bck in visited_fwd
127         if lastword_bck in visited_fwd:
128             return pathlen_bck + visited_fwd[lastword_bck][0]
129
130         # # Check if lastword_fwd in queue_bck
131         # for plbck, pth in queue_bck:
132         #     if pth[-1] == lastword_fwd:
133         #         return pathlen_fwd + plbck
134
135         # # check if lastword_bck in queue_fwd
136         # for plfwd, pth in queue_fwd:
137         #     if pth[-1] == lastword_bck:
138         #         return pathlen_bck + plfwd
139
140
141     # Explore forward path
142     visited_fwd[lastword_fwd] = (pathlen_fwd, path_fwd)

```

```
143     neighbors_fwd = wordgraph[lastword_fwd]
144     for w in neighbors_fwd:
145         if not (w in visited_fwd):
146             heappush(queue_fwd, (pathlen_fwd + 1, path_fwd + [w]))
147
148     # Explore backward path
149     visited_bck[lastword_bck] = (pathlen_bck, path_bck)
150     neighbors_bck = wordgraph[lastword_bck]
151     for w in neighbors_bck:
152         if not (w in visited_bck):
153             heappush(queue_bck, (pathlen_bck + 1, path_bck + [w]))
154
155
156     return 0
```

Leetcode 128: Longest Consecutive Sequence

```
1 class Solution:
2     # time: O(n log n), space O(n)
3     def longestConsecutive(self, nums: List[int]) -> int:
4         n = len(nums)
5         if n == 0:
6             return 0
7
8         nums.sort() # n log n
9         count = 1
10        for i in range(1, n):
11            if nums[i] - nums[i - 1] == 1:
12                count += 1
13            elif nums[i] == nums[i - 1]:
14                pass
15            else:
16                count = 1
17        return count
```

Leetcode 129: Sum Root To Leaf Numbers

```
1 # Definition for a binary tree node.
2 class TreeNode:
3     def __init__(self, val=0, left=None, right=None):
4         self.val = val
5         self.left = left
6         self.right = right
7 class Solution:
8     def __init__(self):
9         self.sum = 0
10
11     def func(self, node, digits):
12         if node is None:
13             return
14
15         # Words 'leaf node' should remind you to check
16         # node.left and node.right
17         if (node.left is None) and (node.right is None):
18             digits = digits + [node.val]
19             num = int(''.join(str(d) for d in digits))
20             self.sum += num
21             return
22
23         self.func(node.left, digits + [node.val])
24         self.func(node.right, digits + [node.val])
25
26     def sumNumbers(self, root: TreeNode) -> int:
27         self.func(root, [])
28         return self.sum
```

Leetcode 130: Surrounded Regions

```
1 class Solution:
2     def solve(self, board: List[List[str]]) -> None:
3         """
4         Do not return anything, modify board in-place instead.
5         """
6
7         """
8         Algorithm
9
10        We will do BFS from all boundary cells and mark the
11        all 'O' cells that can be reached from the boundary.
12        The remaining 'O' cells can be marked with 'X'
13        """
14        visited = set()
15        queue = []
16
17        m = len(board)
18        n = len(board[0])
19
20        # Initial population of queue
21        for i in range(m):
22            if board[i][0] == 'O':
23                queue.insert(0, (i, 0))
24            if board[i][n - 1] == 'O':
25                queue.insert(0, (i, n - 1))
26
27        for j in range(n):
28            if board[0][j] == 'O':
29                queue.insert(0, (0, j))
30            if board[m - 1][j] == 'O':
31                queue.insert(0, (m - 1, j))
32
33        while queue:
34            i, j = queue.pop()
35            nextpos = [(i - 1, j), (i + 1, j), (i, j - 1), (i, j + 1)]
36            for ni, nj in nextpos:
37                if (0 <= ni < m) and (0 <= nj < n) and board[ni][nj] == 'O':
38                    if not (ni, nj) in visited:
39                        queue.insert(0, (ni, nj))
40
41            visited.add((i, j))
42
43        for i in range(m):
44            for j in range(n):
45                if board[i][j] == 'O' and (not (i, j) in visited):
46                    board[i][j] = 'X'
```


Leetcode 131: Palindrome Partitioning

```
1 class Solution:
2     def __init__(self):
3         self.partitions = []
4
5     def func(self, partition, s):
6         n = len(s)
7
8         # Potentially redundant
9         if n == 0:
10            self.partitions.append(partition)
11            return
12
13        if n == 1:
14            self.partitions.append(partition + [s])
15            return
16
17        for i in range(1, n + 1):
18            # We loop from 1 to n + 1, because otherwise, the empty string
19            # would always be a palindrome and the recursion wont terminate
20            next_partition = s[:i]
21            if next_partition == next_partition[::-1]: # palindrome testing
22                self.func(partition + [next_partition], s[i:])
23
24        def partition(self, s: str) -> List[List[str]]:
25            self.func([], s)
26            return self.partitions
```

Leetcode 132: Palindrome Partitioning 2

```
1 class Solution:
2     def ispal(self, x):
3         return x == x[::-1]
4
5
6     def palindromeTable(self, s):
7         n = len(s)
8         ptable = [[0 for _ in range(n)] for _ in range(n)]
9         ptable[n - 1][n - 1] = 1
10
11        for i in range(n - 1):
12            ptable[i][i] = 1
13            ptable[i][i + 1] = int(s[i] == s[i + 1])
14
15        for w in range(2, n):
16            for i in range(n - w):
17                j = i + w
18                if (ptable[i + 1][j - 1] == 1) and (s[i] == s[j]):
19                    ptable[i][j] = 1
20
21        return ptable
22
23    def minCut(self, s: str) -> int:
24        """
25        Time: O(n^3), Space O(n)
26
27        The main idea is to use a 1D bottom up DP. T[i] is the
28        minimum number of partitions required to get palindromic
29        substrings for s[0..i]. We can compute T[i] in the
30        following way:
31
32        x x x x x x x x x
33          j   i
34
35        With reference to the above diagram. If string s[j..i] is
36        a palindrome, then T[i] is one plus T[j - 1]. I.e. if we
37        get a palindromic chunk for j..i, then the number of partitions
38        is simply one plus the number required up till j - 1.
39
40        Else, it is simply one plus the number of partitions required
41        up to the previous character.
42
43        Final subtlety is to do this for all j from 0..i and take the
44        best answer.
45
46        The O(n^3) can be reduced to O(n^2) by precomputing the
47        palindromeness for each (i, j)
48
49        """
50        n = len(s)
51        ptable = self.palindromeTable(s)
52
53        T = list(range(n))
54        for i in range(1, n):
55            if ptable[0][i] == 1:
56                T[i] = 0
57                continue
58
59            for j in range(i):
60                if ptable[j][i] == 1:
61                    T[i] = min(T[i], T[j - 1] + 1)
62                else:
63                    T[i] = min(T[i], T[i - 1] + 1)
64
65        return T[-1]
```

Leetcode 133: Clone Graph

```
1 """
2 # Definition for a Node.
3 class Node:
4     def __init__(self, val = 0, neighbors = None):
5         self.val = val
6         self.neighbors = neighbors if neighbors is not None else []
7 """
8
9 class Solution:
10     def cloneGraph(self, node: 'Node') -> 'Node':
11         """
12         Approach:
13
14         Serialize into an explicit adjacency list and build new.
15         """
16
17         if node is None:
18             return
19
20         head = node
21         # BFS for serialization
22         queue = [head]
23         adjlist = {}
24         visited = set()
25         while queue:
26             node = queue.pop()
27             nbrs = [nb.val for nb in node.neighbors]
28             adjlist[node.val] = nbrs
29             for nb in node.neighbors:
30                 if not (nb.val in visited):
31                     queue.insert(0, nb)
32             visited.add(node.val)
33
34         newnodes = {}
35         for k in adjlist:
36             newnodes[k] = Node(k, [])
37
38         for k, nbidx in adjlist.items():
39             nbrs = [newnodes[i] for i in nbidx]
40             newnodes[k].neighbors = nbrs
41
42         return newnodes[1]
```

Leetcode 134: Gas Station

```
1 class Solution:
2     def circuit(self, gas, cost, i, n):
3         tank = gas[i]
4         for _ in range(n + 1):
5             i1 = (i + 1) % n
6             if tank < cost[i]:
7                 return False
8             tank = tank - cost[i] + gas[i1]
9             i = i1
10
11         return True
12
13     def canCompleteCircuit(self, gas: List[int], cost: List[int]) -> int:
14         n = len(gas)
15         if n == 1:
16             if gas[0] >= cost[0]:
17                 return 0
18             else:
19                 return -1
20
21         startpoints = []
22         for i in range(n):
23             if cost[i] < gas[i]:
24                 startpoints.append(i)
25
26         if len(startpoints) == 0:
27             return -1
28
29         for i in startpoints:
30             if self.circuit(gas, cost, i, n):
31                 return i
32
33         return -1
34
35
36 class Solution:
37     """
38     O(n) solution that I did not come up with
39     """
40     def canCompleteCircuit(self, gas: List[int], cost: List[int]) -> int:
41         if (sum(gas) - sum(cost) < 0):
42             return -1
43
44         tank, start_index = 0, 0
45
46         for i in range(len(gas)):
47             tank += gas[i] - cost[i]
48
49             if tank < 0:
50                 start_index = i + 1
51                 tank = 0
52
53         return start_index
```

Leetcode 135: Candy

```
1 class Solution:
2     def candy(self, ratings: List[int]) -> int:
3         """
4         Need forward and reverse pass. The rest of the
5         logic should be clear from code.
6         """
7         n = len(ratings)
8         T = [1] * n # One candy to each child initially
9
10        # backward looking pass
11        for i in range(1, n):
12            if ratings[i] > ratings[i - 1]:
13                T[i] = T[i - 1] + 1
14
15        # forward looking pass
16        for i in range(n - 2, -1, -1):
17            if ratings[i] > ratings[i + 1]:
18                T[i] = max(T[i], T[i + 1] + 1)
19
20        return sum(T)
```

Leetcode 136: Single Number

```
1 class Solution:
2     def singleNumber(self, nums: List[int]) -> int:
3         """
4         Idea:
5
6         Sort the numbers and alternatively add and subtract the
7         consecutive numbers from 'count'. What remains in the end
8         is the single number.
9         """
10        nums.sort()
11        s = 0
12        sign = 1
13        for i in nums:
14            s += sign * i
15            sign *= -1
16
17        return s
```

Leetcode 138: Copy List With Random Pointer

```
1
2 # Definition for a Node.
3 class Node:
4     def __init__(self, x: int, next: 'Node' = None, random: 'Node' = None):
5         self.val = int(x)
6         self.next = next
7         self.random = random
8
9 class Solution:
10     def copyRandomList(self, head: 'Node') -> 'Node':
11         """
12         IDEA
13
14         Two pass solution.
15
16         Pass1: we copy the linked list w/o random pointers and
17                create a mapping of old nodes to new nodes.
18         Pass2: we fill in random pointer information with the
19                help of the map.
20         """
21
22         # Copy list w/o random pointers
23         node = head
24         sentinel = newnode = Node(-1001)
25         mapping = {}
26         while node:
27             nextnode = Node(-1001)
28             newnode.next = nextnode
29             newnode = newnode.next
30             newnode.val = node.val
31             mapping[id(node)] = newnode
32             node = node.next
33
34         # Copy random pointer information
35         node = head
36         newnode = sentinel.next
37         while node:
38             r = node.random
39             if not (r is None):
40                 newnode.random = mapping[id(r)]
41             node = node.next
42             newnode = newnode.next
43
44         return sentinel.next
```

Leetcode 139: Word Break

```
1 class Solution:
2     def wordBreak(self, s: str, wordDict: List[str]) -> bool:
3         wordDict = set(wordDict)
4         wordDict.add('')
5         n = len(s)
6         T = [False] * (n + 1)
7         T[0] = True
8         for i in range(n + 1):
9             for j in range(i):
10                 if T[j] and (s[j: i] in wordDict):
11                     T[i] = True
12                     break
13
14         print(T)
15         return T[-1]
```


Leetcode 141: Linked List Cycle

```

1  # Definition for singly-linked list.
2  # class ListNode:
3  #     def __init__(self, x):
4  #         self.val = x
5  #         self.next = None
6
7  class Solution:
8      def hasCycle(self, head: ListNode) -> bool:
9          slow = fast = head
10
11         while fast:
12             slow = slow.next
13
14             if fast.next:
15                 fast = fast.next.next
16             else:
17                 return False
18
19             if slow == fast:
20                 return True
21
22         return False

```

Leetcode 142: Linked List Cycle 2

```
1 # Definition for singly-linked list.
2 # class ListNode:
3 #     def __init__(self, x):
4 #         self.val = x
5 #         self.next = None
6
7 class Solution:
8     """
9     https://en.wikipedia.org/wiki/Cycle\_detection
10     Jump to section
11     "Floyd's tortoise and hare"
12     """
13     def detectCycle(self, head: ListNode) -> ListNode:
14         slow = fast = head
15         while fast:
16             slow = slow.next
17
18             if fast.next:
19                 fast = fast.next.next
20             else:
21                 return
22
23             if slow == fast:
24                 break
25
26         if fast is None:
27             return
28
29         slow = head
30         while slow != fast:
31             slow = slow.next
32             fast = fast.next
33
34         return slow
```

Leetcode 143: Reorder List

```
1 # Definition for singly-linked list.
2 # class ListNode:
3 #     def __init__(self, val=0, next=None):
4 #         self.val = val
5 #         self.next = next
6 class Solution:
7     def reorderList(self, head: ListNode) -> None:
8         """
9         Do not return anything, modify head in-place instead.
10        """
11        if not head: return
12        if not head.next: return
13
14        # Create list of nodes
15        nodes = []
16        node = head
17        while node:
18            nodes.append(node)
19            node = node.next
20
21        # Relink
22        n = len(nodes)
23        i = 0
24        j = n - 1
25        while i < n // 2:
26            revnode = nodes[j]
27            nodes[i].next = revnode
28            nodes[j].next = nodes[i + 1]
29            i += 1
30            j -= 1
31
32        nodes[i].next = None
```

Leetcode 144: Binary Tree Preorder Traversal

```
1 class Solution:
2     def __init__(self):
3         self.vals = []
4     def func(self, root):
5         if not root:
6             return
7
8         yield root.val
9         yield from self.func(root.left)
10        yield from self.func(root.right)
11
12    def preorderTraversal(self, root: TreeNode) -> List[int]:
13        return list(self.func(root))
```

Leetcode 145: Binary Tree Postorder Traversal

```
1 # Definition for a binary tree node.
2 # class TreeNode:
3 #     def __init__(self, val=0, left=None, right=None):
4 #         self.val = val
5 #         self.left = left
6 #         self.right = right
7 class Solution:
8     def func(self, node):
9         if node is None:
10             return
11         yield from self.func(node.left)
12         yield from self.func(node.right)
13         yield node.val
14
15     def postorderTraversal(self, root: TreeNode) -> List[int]:
16         return list(self.func(root))
```

Leetcode 146: Lru Cache

```
1 class LRUCache:
2
3     def __init__(self, capacity: int):
4         self.capacity = capacity
5         self.ranks = []
6         self.kv = {}
7
8     def get(self, key: int) -> int:
9         val = self.kv.get(key, -1)
10
11         # Reorder keys
12         if val != -1:
13             r = self.ranks.index(key)
14             k = self.ranks.pop(r)
15             self.ranks.append(k)
16
17         return val
18
19     def put(self, key: int, value: int) -> None:
20         if key in self.kv:
21             self.kv[key] = value
22             r = self.ranks.index(key)
23             k = self.ranks.pop(r)
24             self.ranks.append(k)
25             return
26
27         if len(self.kv) == self.capacity:
28             lru_key = self.ranks.pop(0)
29             self.kv.pop(lru_key)
30             self.ranks.append(key)
31             self.kv[key] = value
32         else:
33             self.kv[key] = value
34             self.ranks.append(key)
35
36
37 # Your LRUCache object will be instantiated and called as such:
38 # obj = LRUCache(capacity)
39 # param_1 = obj.get(key)
40 # obj.put(key,value)
```

Leetcode 147: Insertion Sort List

```
1 class Solution:
2     """
3     O(n) time, O(1) space
4     Not my solution
5     """
6     def insertionSortList(self, head: ListNode) -> ListNode:
7         dummy_head = ListNode()
8         curr = head
9
10        while curr:
11            prev_pointer = dummy_head
12            next_pointer = prev_pointer.next
13
14            while next_pointer:
15                if curr.val < next_pointer.val:
16                    break
17
18                prev_pointer = prev_pointer.next
19                next_pointer = next_pointer.next
20
21            temp = curr.next
22            curr.next = next_pointer
23            prev_pointer.next = curr
24            curr = temp
25
26        return dummy_head.next
27
28
29 class Solution:
30     """
31     O(n) time, O(n) space
32     """
33     def insertionSortList(self, head: ListNode) -> ListNode:
34         if not head: return
35         if not head.next: return head
36
37         vals = []
38         node = head
39
40         # Copy nodes into array
41         while node:
42             vals.append(node.val)
43             node = node.next
44
45         # Insertion sort
46         n = len(vals)
47         for i in range(1, n):
48             j = i - 1
49             key = vals[i]
50             while j >= 0 and key < vals[j]:
51                 vals[j + 1] = vals[j]
52                 j -= 1
53             vals[j + 1] = key
54
55         # Build new list
56         sentinel = node = ListNode()
57         for v in vals:
58             nxt = ListNode(v)
59             node.next = nxt
60             node = node.next
61         return sentinel.next
```

Leetcode 149: Max Points On A Line

```
1 from typing import List
2 from collections import defaultdict
3 import math
4
5 class Solution:
6     def maxPoints(self, points: List[List[int]]) -> int:
7         n = len(points)
8         if n == 1: return 1
9         lines = defaultdict(int)
10        for i in range(n):
11            xi, yi = points[i]
12            for j in range(i + 1, n):
13                xj, yj = points[j]
14
15                # Vertical line
16                if xi == xj:
17                    m = 'inf'
18                    c = xi
19                    lines[(m, c)] += 1
20                    continue
21
22                # Regular lines
23                m = (yj - yi) / (xj - xi)
24                c = yj - m * xj
25
26                # Matching with existing lines
27                matched = False
28                tol = 1.0e-6
29                for ml, cl in lines.keys():
30                    if ml == 'inf': continue
31                    if (abs(ml - m) < tol) and (abs(cl - c) < tol):
32                        lines[(ml, cl)] += 1
33                        matched = True
34
35                # Create new line
36                if not matched:
37                    lines[(m, c)] += 1
38
39                # The counter at each value is V = k(k-1)/2 where
40                # k is the number of points on that line. To retrieve
41                # the number of points, we have to solve a quadratic.
42                V = max(lines.values())
43                numpoints = 0.5 * (1 + math.sqrt(1 + 8 * V))
44                return int(math.floor(numpoints))
```


Leetcode 150: Evaluate Reverse Polish Notation

```
1 class Solution:
2     def evalRPN(self, tokens: List[str]) -> int:
3         stack = []
4         op = {'+', '-', '*', '/'}
5         while tokens:
6             tok = tokens.pop()
7             if not (tok in op):
8                 stack.append(int(tok))
9             else:
10                n2 = stack.pop() # Second operand
11                n1 = stack.pop() # First operand
12
13                if tok == '+':
14                    stack.append(n1 + n2)
15                elif tok == '-':
16                    stack.append(n1 - n2)
17                elif tok == '*':
18                    stack.append(n1 * n2)
19                elif tok == '/':
20                    stack.append(int(n1 / n2))
21
22         return stack[0]
```

Leetcode 153: Find Minimum In Rotated Sorted Array

```
1 class Solution:
2     def findMin(self, nums):
3         n = len(nums)
4
5         if nums[0] < nums[n - 1]:
6             return nums[0]
7
8         if n == 1:
9             return nums[0]
10
11        left, right = 0, n - 1
12
13        # Note that in a standrd binary sear
14        while left < right:
15            mid = (left + right) // 2
16            if nums[mid] > nums[left]:
17                left = mid
18            else:
19                right = mid
20
21        return nums[left + 1]
22
23 # Official solution
24 class Solution(object):
25     def findMin(self, nums):
26         if len(nums) == 1:
27             return nums[0]
28
29        left, right = 0, len(nums) - 1
30
31        # Array not rotated
32        if nums[right] > nums[0]:
33            return nums[0]
34
35        while right >= left:
36            mid = left + (right - left) / 2
37            if nums[mid] > nums[mid + 1]:
38                return nums[mid + 1]
39            if nums[mid - 1] > nums[mid]:
40                return nums[mid]
41
42        if nums[mid] > nums[0]:
43            left = mid + 1
44        else:
45            right = mid - 1
46
```

Leetcode 154: Find Minimum In Rotated Sorted Array 2

Leetcode 162: Find Peak Element

```
1 class Solution:
2     def findPeakElement(self, nums: List[int]) -> int:
3         n = len(nums)
4         if n == 1:
5             return 0
6
7         if nums[0] > nums[1]:
8             return 0
9         if nums[n - 1] > nums[n - 2]:
10            return n - 1
11
12        left, right = 0, n - 1
13        while left < right:
14            mid = (left + right) // 2
15
16            if nums[mid - 1] < nums[mid] and nums[mid + 1] < nums[mid]:
17                return mid
18
19            if nums[mid - 1] < nums[mid]:
20                left = mid
21            else:
22                right = mid
```

Leetcode 166: Fraction To Recurring Decimal

```
1 class Solution:
2     def fractionToDecimal(self, numerator: int, denominator: int) -> str:
3         N = numerator
4         D = denominator
5         sign = '-' if N * D < 0 else ''
6
7         N = abs(N)
8         D = abs(D)
9
10        int_part = (N // D)
11        r = N % D
12        seen = []
13        quotients = []
14
15        while r > 0 and (not r in seen):
16            seen.append(r)
17            quotients.append(10 * r // D)
18            r = (10 * r) % D
19
20
21        # No fractional part
22        if len(quotients) == 0:
23            return f'{sign}{int_part}'
24
25        # Non recurring fractional part
26        if r == 0:
27            frac_part = ''.join(str(f) for f in quotients)
28            return f'{sign}{int_part}.{frac_part}'
29
30        # Recurring fraction
31        idx = seen.index(r)
32        unique_part = ''.join(str(q) for q in quotients[:idx])
33        repeating_part = ''.join(str(q) for q in quotients[idx:])
34        frac_part = f'{unique_part}({repeating_part})'
35        return f'{sign}{int_part}.{frac_part}'
```

Leetcode 168: Excel Sheet Column Title

```
1 class Solution:
2     def convertToTitle(self, columnNumber: int) -> str:
3         nums = range(1, 27)
4         letters = 'ABCDEFGHIJKLMNOPQRSTUVWXYZ'
5         mapping = dict(zip(nums, letters))
6
7         q = 1
8         n = columnNumber
9         title = []
10        while n > 0:
11            n, r = n // 26, n % 26
12            if r == 0:
13                r = 26
14            n -= 1
15
16            title.insert(0, mapping[r])
17        return ''.join(title)
```

Leetcode 169: Majority Element

```
1 from typing import List
2
3 class Solution:
4     def quickselect(self, arr, k):
5         if len(arr) == 1:
6             return arr[0]
7
8         pivot = arr[-1]
9         lows = [e for e in arr if e < pivot]
10        highs = [e for e in arr if e > pivot]
11        pivots = [e for e in arr if e == pivot]
12
13        if k <= len(lows):
14            return self.quickselect(lows, k)
15        elif k <= len(lows) + len(pivots):
16            return pivots[0]
17        else:
18            return self.quickselect(highs, k - len(lows) - len(pivots))
19
20    def majorityElement(self, nums: List[int]) -> int:
21        n = len(nums)
22        return self.quickselect(nums, n // 2 + 1)
```

Leetcode 173: Binary Search Tree Iterator

```
1 # Definition for a binary tree node.
2 # class TreeNode:
3 #     def __init__(self, val=0, left=None, right=None):
4 #         self.val = val
5 #         self.left = left
6 #         self.right = right
7 class BSTIterator:
8
9     def func(self, node):
10         if node.left:
11             yield from self.func(node.left)
12
13         yield node.val
14
15         if node.right:
16             yield from self.func(node.right)
17
18     def __init__(self, root: TreeNode):
19         self.generator = self.func(root)
20         self.nextval = next(self.generator)
21
22     def next(self) -> int:
23         if not (self.nextval is None):
24             retval = self.nextval
25             try:
26                 self.nextval = next(self.generator)
27             except StopIteration:
28                 self.nextval = None
29             return retval
30
31
32     def hasNext(self) -> bool:
33         return not (self.nextval is None)
34
35
36 # Your BSTIterator object will be instantiated and called as such:
37 # obj = BSTIterator(root)
38 # param_1 = obj.next()
39 # param_2 = obj.hasNext()
```


Leetcode 198: House Robber

```
1 from typing import List
2
3 class Solution:
4     def rob(self, nums: List[int]) -> int:
5         n = len(nums)
6         if n == 0:
7             return 0
8         if n == 1:
9             return nums[0]
10
11         T = [0] * n
12         T[0] = nums[0]
13         T[1] = max(T[0], nums[1])
14
15         for i in range(2, n):
16             T[i] = max(T[i - 1], nums[i] + T[i - 2])
17
18         return T[-1]
```

Leetcode 200: Number Of Islands

```
1 from typing import List
2
3 class Solution:
4     def bfs(self, grid, r, c, visited):
5         m = len(grid)
6         n = len(grid[0])
7         queue = [(r, c)]
8         while queue:
9             i, j = queue.pop()
10            visited.add((i, j))
11            nbrs = [(i, j - 1), (i, j + 1), (i - 1, j), (i + 1, j)]
12            for p, q in nbrs:
13                if (0 <= p < m ) and (0 <= q < n):
14                    if (grid[p][q] == '1') and (not (p, q) in visited):
15                        queue.append((p, q))
16
17
18     def numIslands(self, grid: List[List[str]]) -> int:
19         m = len(grid)
20         n = len(grid[0])
21         visited = set()
22         num_islands = 0
23         for i in range(m):
24             for j in range(n):
25                 if (grid[i][j] == '1') and (not (i, j) in visited):
26                     self.bfs(grid, i, j, visited)
27                     num_islands += 1
28
29         return num_islands
```

Leetcode 206: Reverse Linked List

```
1 # Definition for singly-linked list.
2 class ListNode:
3     def __init__(self, val=0, next=None):
4         self.val = val
5         self.next = next
6
7 class Solution:
8     def reverseList(self, head: ListNode) -> ListNode:
9         if not head: return None
10
11         prev = head
12         curr = head.next
13         while curr:
14             nxt = curr.next
15             curr.next = prev
16             prev = curr
17             curr = nxt
18         head.next = None
19         return prev
```

Leetcode 207: Course Schedule

```
1 class Solution:
2     def _nodevisitor(self, v, adjacency_list, visited, stack):
3         visited.add(v)
4         stack.add(v)
5
6         for nbr in adjacency_list[v]:
7             if not (nbr in visited):
8                 if self._nodevisitor(nbr, adjacency_list, visited, stack) == True:
9                     return True
10            elif nbr in stack:
11                return True
12
13        stack.remove(v)
14        return False
15
16    def isCyclic(self, adjacency_list):
17        visited = set()
18        for v in adjacency_list:
19            stack = set()
20            if not (v in visited):
21                if self._nodevisitor(v, adjacency_list, visited, stack) == True:
22                    return True
23
24        return False
25
26
27    def canFinish(self, numCourses: int, prerequisites: List[List[int]]) -> bool:
28        prereqs = prerequisites
29        adjacency_list = defaultdict(list)
30
31        for child, parent in prereqs:
32            adjacency_list[child].append(parent)
33            if not (parent in adjacency_list):
34                adjacency_list[parent] = []
35
36        return not self.isCyclic(adjacency_list)
```

Leetcode 208: Implement Trie Prefix Tree

```
1 class Node:
2     def __init__(self, val='', children=None):
3         self.val = val
4         if children is None:
5             self.children = dict()
6         else:
7             self.children = children
8         self.isword = False
9
10
11 class Trie:
12     def __init__(self):
13         self.root = Node()
14
15     def insert(self, word):
16         node = self.root
17         for c in word:
18             if not (c in node.children):
19                 node.children[c] = Node()
20             node = node.children[c]
21         node.isword = True
22
23     def searchPrefix(self, word):
24         node = self.root
25         for c in word:
26             if len(node.children) == 0:
27                 return
28             if not (c in node.children):
29                 return
30             node = node.children[c]
31
32         return node
33
34     def startsWith(self, prefix):
35         return bool(self.searchPrefix(prefix))
36
37     def search(self, word):
38         node = self.searchPrefix(word)
39         return (node is not None) and node.isword
```

Leetcode 209: Minimum Size Subarray Sum

```
1 class Solution:
2     def minSubArrayLen(self, target: int, nums: List[int]) -> int:
3         left = 0
4         min_length = float('inf')
5         n = len(nums)
6         tot = 0
7         for right in range(n):
8             tot += nums[right]
9
10            while tot >= target:
11                min_length = min(min_length, right - left + 1)
12                tot -= nums[left]
13                left += 1
14
15        ans = 0 if min_length == float('inf') else min_length
16        return ans
```

Leetcode 210: Course Schedule 2

```
1 class Solution:
2     def __init__(self):
3         self.is_cyclic = False
4
5     def dfs(self, v, graph, visited, path, stack):
6         if self.is_cyclic:
7             return
8
9         visited.add(v)
10        stack.add(v)
11        for c in graph[v]:
12            if not (c in visited):
13                self.dfs(c, graph, visited, path, stack)
14            elif c in stack:
15                self.is_cyclic = True
16        path.append(v)
17        stack.remove(v)
18
19    def findOrder(self, numCourses: int, prerequisites: List[List[int]]) -> List[int]:
20
21        # Build adjacency list
22        graph = {}
23        prereqs = prerequisites
24        for i in range(numCourses):
25            graph[i] = []
26
27        for child, parent in prereqs:
28            graph[parent].append(child)
29
30        # Get paths
31        paths = []
32        visited = set()
33        for v in graph:
34            path = []
35            stack = set()
36            if not (v in visited):
37                self.dfs(v, graph, visited, path, stack)
38            paths.extend(path)
39        return [] if self.is_cyclic else paths[::-1]
```

Leetcode 211: Design Add And Search Words Data Structure

```
1 class TrieNode:
2     def __init__(self, is_end=False, children=None):
3         if children is None:
4             self.children = {}
5         else:
6             self.children = children
7
8         self.is_end = is_end
9
10 class WordDictionary:
11
12     def __init__(self):
13         """
14         Initialize your data structure here.
15         """
16         self.root = TrieNode()
17
18     def addWord(self, word: str) -> None:
19         node = self.root
20         for c in word:
21             if not (c in node.children):
22                 node.children[c] = TrieNode()
23             node = node.children[c]
24         node.is_end = True
25
26     def func(self, word, curr_node):
27         for i, char in enumerate(word):
28             if char == '.':
29                 # Recursively search in all children of the current node
30                 for child in curr_node.children:
31                     if self.func(word[i + 1: ], curr_node.children[child]) == True:
32                         return True
33             return False
34
35         # Standard Trie search
36         elif not (char in curr_node.children):
37             return False
38         elif char in curr_node.children:
39             curr_node = curr_node.children[char]
40
41         return curr_node.is_end
42
43     def search(self, word: str) -> bool:
44         return self.func(word, self.root)
45
46
47 # Your WordDictionary object will be instantiated and called as such:
48 # obj = WordDictionary()
49 # obj.addWord(word)
50 # param_2 = obj.search(word)
```


Leetcode 212: Word Search 2

```
1 from typing import List
2
3 class Solution:
4     def dfs(self, board, word, i, j, k, visited):
5         m = len(board)
6         n = len(board[0])
7         w = len(word)
8         if k == w:
9             return True
10
11         nbrs = [(i - 1, j), (i, j - 1), (i, j + 1), (i + 1, j)]
12         found = False
13         for r, c in nbrs:
14             if (0 <= r <= m - 1) and (0 <= c <= n - 1):
15                 if (not (r, c) in visited) and (board[r][c] == word[k]):
16                     nv = visited.union({(r, c)})
17                     found = found or self.dfs(board, word, r, c, k + 1, nv)
18
19         return found
20
21
22 def findWords(self, board: List[List[str]], words: List[str]) -> List[str]:
23     found_words = []
24     m = len(board)
25     n = len(board[0])
26
27     for word in words:
28         if set(word).difference()
29         positions = [(i, j) for i in range(m) for j in range(n) if board[i][j] == word[0]]
30         for i, j in positions:
31             if self.dfs(board, word, i, j, 1, {(i, j)}):
32                 found_words.append(word)
33                 break
34
35     return found_words
```

Leetcode 215: Kth Largest Element In An Array

```
1 from typing import List
2
3 class Solution:
4     def quickselect(self, nums, k):
5         if len(nums) == 1:
6             return nums[0]
7
8         n = len(nums)
9         pivot = nums[n - 1]
10        lows = [e for e in nums if e < pivot]
11        highs = [e for e in nums if e > pivot]
12        pivots = [e for e in nums if e == pivot]
13
14        nl = len(lows)
15        np = len(pivots)
16        nh = len(highs)
17        if k < nl:
18            return self.quickselect(lows, k)
19        elif k < nl + np:
20            return pivots[0]
21        else:
22            return self.quickselect(highs, k - nl - np)
23
24    def findKthLargest(self, nums: List[int], k: int) -> int:
25        ek = self.quickselect(nums, k)
26        return ek
```

Leetcode 216: Combination Sum 3

```
1 class Solution:
2     def __init__(self):
3         self.combinations = set()
4     def func(self, nums, target, path, k):
5         if len(path) == k and target == 0:
6             self.combinations.add(tuple(sorted(path)))
7
8         for n in nums:
9             if (n <= target) and (len(path) < k):
10                newnums = [e for e in nums if e != n and e <= target]
11                self.func(newnums, target - n, path + [n], k)
12
13    def combinationSum3(self, k: int, n: int) -> List[List[int]]:
14        nums = list(range(1, 10))
15        self.func(nums, n, [], k)
16        return list(self.combinations)
```

Leetcode 220: Contains Duplicate 3

```
1 class Solution:
2     def insertInSortedArray(self, nums, a):
3         n = len(nums)
4         if a >= nums[-1]:
5             nums.insert(n - 1, a)
6             return n - 1
7
8         if a <= nums[0]:
9             nums.insert(0, a)
10            return 0
11
12        left, right = 0, n - 1
13        while left <= right:
14            mid = left + (right - left) // 2
15            if nums[mid] == a:
16                nums.insert(mid, a)
17                return
18            elif nums[mid - 1] < a and nums[mid] > a:
19                nums.insert(mid, a)
20                return mid
21            elif nums[mid] < a and nums[mid + 1] > a:
22                nums.insert(mid + 1, a)
23                return mid + 1
24            elif nums[mid] > a:
25                right = mid - 1
26            else:
27                left = mid + 1
28
29        def removeFromSortedArray(self, nums, a):
30            n = len(nums)
31            left, right = 0, n - 1
32            while left <= right:
33                mid = left + (right - left) // 2
34                if nums[mid] == a:
35                    nums.pop(mid)
36                    return
37                elif a < nums[mid]:
38                    right = mid - 1
39                else:
40                    left = mid + 1
41
42        def containsNearbyAlmostDuplicate(self, nums, k, t):
43            n = len(nums)
44            if (n == 1) or (k < 1):
45                return False
46
47            k = min(k, n - 1)
48            kblock = sorted(nums[:k + 1]) # O(k log k)
49            # Test the first chunk exhaustively
50            for i in range(1, k + 1):
51                if abs(kblock[i - 1] - kblock[i]) <= t:
52                    return True
53
54            for i in range(n - k - 1):
55                self.removeFromSortedArray(kblock, nums[i])
56                p = self.insertInSortedArray(kblock, nums[i + k + 1])
57                if p == 0:
58                    diff = abs(kblock[0] - kblock[1])
59                elif p == n - 1:
60                    diff = abs(kblock[n - 1] - kblock[n - 2])
61                if 1 <= p < n - 1:
62                    r = abs(kblock[p] - kblock[p + 1])
63                    l = abs(kblock[p - 1] - kblock[p])
64                    diff = min(l, r)
65                if diff <= t:
66                    return True
67
68            return False
```

Leetcode 221: Maximal Square

```
1 from typing import List
2
3 class Solution:
4     def integralImage(self, M):
5         m = len(M)
6         n = len(M[0])
7         A = [[0 for _ in range(n)] for _ in range(m)]
8         A[0][0] = M[0][0]
9         for i in range(1, n):
10             A[0][i] = A[0][i - 1] + M[0][i]
11
12         for i in range(1, m):
13             A[i][0] = A[i - 1][0] + M[i][0]
14
15         for i in range(1, m):
16             for j in range(1, n):
17                 A[i][j] = M[i][j] + A[i - 1][j] + A[i][j - 1] - A[i - 1][j - 1]
18
19         return A
20
21     def maximalSquare(self, matrix: List[List[str]]) -> int:
22         M = [[int(s) for s in row] for row in matrix]
23         m = len(M)
24         n = len(M[0])
25         A = self.integralImage(M)
26         for r in A: print(r)
27         sqsum = float('-inf')
28         for i in range(m):
29             for j in range(n):
30                 for s in range(min(m - i, n - j)):
31
32                     k, l = i + s, j + s
33                     if s == 0:
34                         S = M[i][j]
35                     elif i == 0 and j == 0:
36                         S = A[k][l]
37                     elif i >= 1 and j >= 1:
38                         S = A[k][l] + A[i - 1][j - 1] - A[i - 1][l] - A[k][j - 1]
39                     elif i == 0 and j >= 1:
40                         S = A[k][l] - A[k][j - 1]
41                     elif j == 0 and i >= 1:
42                         S = A[k][l] - A[i - 1][l]
43
44                     if S < (s + 1) ** 2:
45                         break
46                     else:
47                         sqsum = max(sqsum, S)
48         return 0 if sqsum == float('-inf') else sqsum
```

Leetcode 223: Rectangle Area

```
1 class Solution:
2     def computeArea(self, A, B, C, D, E, F, G, H):
3         a1 = (C - A) * (D - B)
4         a2 = (G - E) * (H - F)
5
6         # Calculate overlaps. I got these expressions by looking at various types
7         # of overlaps and finding pattern. At least I didnt find coming up with these
8         # straightforward, but with experimentation, it is possible.
9         ovy = min(D, H) - max(B, F)
10        ovx = min(C, G) - max(A, E)
11
12        # If any one of the overlaps expressions is negative, then the rectangles are
13        # completely separated. Again, you can convince yourself this by looking at
14        # pictures of a few overlap types.
15        if (ovx < 0) or (ovy < 0):
16            a3 = 0
17        else:
18            a3 = ovx * ovy
19
20        return a1 + a2 - a3
```

Leetcode 224: Basic Calculator

```
1 class Solution:
2     def parse(self, s):
3         tokens = []
4         n = len(s)
5         i = 0
6         while i < n:
7             if s[i] == ' ':
8                 i += 1
9             elif s[i] in '()+-':
10                tokens.append(s[i])
11                i += 1
12            elif s[i] in '0123456789':
13                numtoken = ''
14                while i < n and s[i] in '0123456789':
15                    numtoken += s[i]
16                    i += 1
17
18                tokens.append(numtoken)
19
20        return tokens
21
22    def func(self, tokens, i, res):
23        pass
24
25    def calculate(self, s: str) -> int:
26        tokens = self.parse(s)
```

Leetcode 225: Implement Stack Using Queues

```
1 class Queue:
2     def __init__(self):
3         self.queue = []
4
5     def push(self, num):
6         self.queue.append(num)
7
8     def pop(self):
9         return self.queue.pop(0)
10
11    def top(self):
12        return self.queue[0]
13
14    def empty(self):
15        return len(self.queue) == 0
16
17
18 class MyStack:
19
20     def __init__(self):
21         """
22         Initialize your data structure here.
23         """
24         self.P = Queue()
25         self.Q = Queue()
26
27     def push(self, x: int) -> None:
28         """
29         Push element x onto stack.
30         O(n)
31         """
32         self.P.push(x)
33         while not self.Q.empty():
34             self.P.push(self.Q.pop())
35         self.P, self.Q = self.Q, self.P
36
37     def pop(self) -> int:
38         """
39         Removes the element on top of the stack and returns that element.
40         """
41         return self.Q.pop()
42
43     def top(self) -> int:
44         """
45         Get the top element.
46         """
47         return self.Q.top()
48
49     def empty(self) -> bool:
50         """
51         Returns whether the stack is empty.
52         """
53         return self.Q.empty()
54
55
56 # Your MyStack object will be instantiated and called as such:
57 # obj = MyStack()
58 # obj.push(x)
59 # param_2 = obj.pop()
60 # param_3 = obj.top()
61 # param_4 = obj.empty()
```


Leetcode 226: Invert Binary Tree

```
1 # Definition for a binary tree node.
2 # class TreeNode:
3 #     def __init__(self, val=0, left=None, right=None):
4 #         self.val = val
5 #         self.left = left
6 #         self.right = right
7 class Solution:
8     def func(self, node):
9         if node is None:
10             return
11
12         if (node.left is None) and (node.right is None):
13             return
14
15         node.left, node.right = node.right, node.left
16
17         if node.left:
18             self.func(node.left)
19         if node.right:
20             self.func(node.right)
21
22     def invertTree(self, root: TreeNode) -> TreeNode:
23         self.func(root)
24         return root
```

Leetcode 228: Summary Ranges

```
1 class Solution:
2     def summaryRanges(self, nums: List[int]) -> List[str]:
3         l = r = 0
4         n = len(nums)
5         ranges = []
6         while r < n:
7             while (r < n - 1) and (nums[r + 1] - nums[r] == 1):
8                 r += 1
9
10
11             if r > l:
12                 curr_range = f'{nums[l]}->{nums[r]}'
13             else:
14                 curr_range = f'{nums[l]}'
15
16             ranges.append(curr_range)
17             l = r = r + 1
18
19         return ranges
```

Leetcode 230: Kth Smallest Element In Binary Tree

```
1 # Definition for a binary tree node.
2 # class TreeNode:
3 #     def __init__(self, val=0, left=None, right=None):
4 #         self.val = val
5 #         self.left = left
6 #         self.right = right
7 class Solution:
8     def __init__(self):
9         self.vals = []
10
11     def func(self, node, k):
12         if len(self.vals) == k:
13             return
14
15         if node is None:
16             return
17
18         self.func(node.left, k)
19         self.vals.append(node.val)
20         self.func(node.right, k)
21
22     def kthSmallest(self, root: TreeNode, k: int) -> int:
23         self.func(root, k)
24         return self.vals[k - 1]
```

Leetcode 232: Implement Queue Using Stacks

```
1 class Stack:
2     def __init__(self):
3         self.lst = []
4
5     def push(self, x):
6         self.lst.append(x)
7
8     def pop(self):
9         if len(self.lst) > 0:
10             return self.lst.pop()
11
12     def peek(self):
13         if len(self.lst) > 0:
14             return self.lst[-1]
15
16     def empty(self):
17         return len(self.lst) == 0
18
19
20 class MyQueue:
21
22     def __init__(self):
23         self.P = Stack()
24         self.Q = Stack()
25
26     def _QtoP(self):
27         if self.P.empty():
28             while not self.Q.empty():
29                 self.P.push(self.Q.pop())
30
31
32     def push(self, x: int) -> None:
33         self.Q.push(x)
34
35     def pop(self) -> int:
36         self._QtoP()
37         return self.P.pop()
38
39     def peek(self) -> int:
40         self._QtoP()
41         return self.P.peek()
42
43     def empty(self) -> bool:
44         return self.P.empty() and self.Q.empty()
45
46
47 # Your MyQueue object will be instantiated and called as such:
48 # obj = MyQueue()
49 # obj.push(x)
50 # param_2 = obj.pop()
51 # param_3 = obj.peek()
52 # param_4 = obj.empty()
```

Leetcode 233: Number Of Digit One

```
1 import math
2
3 def bruteforce(n):
4     res = 0
5     for k in range(n + 1):
6         res += sum(1 for x in str(k) if x == '1')
7     return res
8
9
10 class Solution:
11     def countOnes(self, N):
12         if N == 0:
13             return 0
14
15         p = int(math.log10(N))
16         x = 10 ** p
17         k = p * x // 10
18         if N == x:
19             return k + 1
20         else:
21             return x + (N // x) * k
22
23     def countDigitOne(self, n: int) -> int:
24         m = n
25         p = 10
26         res = 0
27         dsum = 0
28         while m > 0:
29             d = m % p
30             res += self.countOnes(d)
31
32             # Whenever the most significant digit of the remainder ('d') is 1,
33             # the number of 1's in the answer increases by whatever was the
34             # sum of previous remainders. For example, if N = 2121, then
35             # we cant simply break it as 2000 + 100 + 20 + 1. Because of
36             # that 1 in the hundreds place, 21 more ones would be added to the
37             # answer. We have to account for those
38             MSD = 10 * d / p # Most significant digit; can also be computed as str(d)[0]
39             if MSD == 1:
40                 res += dsum
41
42             dsum += d
43             m -= d
44             p *= 10
45         return res
```

Leetcode 234: Palindrome Linked List

```
1 class Solution:
2     def isPalindrome_(self, head: ListNode) -> bool:
3         node = head
4         lst = []
5         while node:
6             lst.append(node.val)
7             node = node.next
8
9         return lst == lst[::-1]
10
11    def isPalindrome(self, head: ListNode) -> bool:
12        node = head
13        l = 0
14        while node:
15            l += 1
16            node = node.next
17
18        mid = l // 2
19
20        # Travel to mid position
21        right_head = head
22        for i in range(mid):
23            right_head = right_head.next
24
25        # Reverse the list from right_head
26        prev = None
27        curr = right_head
28        while curr:
29            nxt = curr.next
30            curr.next = prev
31            prev = curr
32            curr = nxt
33
34        lnode = head
35        rnode = prev
36        for i in range(mid):
37            if lnode.val != rnode.val:
38                return False
39            lnode = lnode.next
40            rnode = rnode.next
41
42        return True
```

Leetcode 235: Lowest Common Ancestor Of Binary Search Tree

```
1 class Solution:
2     def __init__(self):
3         self.lca = None
4
5     def func(self, node, p, q):
6         if (not node) or self.lca:
7             return False, False
8
9         pl, ql = self.func(node.left, p, q)
10        pr, qr = self.func(node.right, p, q)
11        foundp = (node.val == p) or pl or pr
12        foundq = (node.val == q) or ql or qr
13        if foundp and foundq:
14            if not self.lca:
15                self.lca = node
16        return foundp, foundq
17
18    def lowestCommonAncestor(self, root, p, q):
19        self.func(root, p.val, q.val)
20        return self.lca
```

Leetcode 236: Lowest Common Ancestor Of Binary Tree

```
1 class Solution:
2     def __init__(self):
3         self.lca = None
4
5     def func(self, node, p, q):
6         if (not node) or self.lca:
7             return False, False
8
9         pl, ql = self.func(node.left, p, q)
10        pr, qr = self.func(node.right, p, q)
11        foundp = (node.val == p) or pl or pr
12        foundq = (node.val == q) or ql or qr
13        if foundp and foundq:
14            if not self.lca:
15                self.lca = node
16        return foundp, foundq
17
18    def lowestCommonAncestor(self, root, p, q):
19        self.func(root, p.val, q.val)
20        return self.lca
```


Leetcode 239: Sliding Window Maximum

```
1 class Heap:
2     def __init__(self, arr):
3         self.arr = sorted(arr)
4
5     def insert(self, x):
6         arr = self.arr
7         n = len(arr)
8         if n == 0:
9             self.arr.append(x)
10            return
11
12        if x >= arr[-1]:
13            arr.append(x)
14            return
15
16        if x <= arr[0]:
17            arr.insert(0, x)
18            return
19
20        left, right = 0, n - 1
21        while left <= right:
22            mid = left + (right - left) // 2
23            if arr[mid] == x:
24                arr.insert(mid, x)
25                return
26            elif arr[mid] < x and arr[mid + 1] > x:
27                arr.insert(mid + 1, x)
28                return
29            elif arr[mid] > x and arr[mid - 1] < x:
30                arr.insert(mid, x)
31                return
32            elif x < arr[mid]:
33                right = mid - 1
34            else:
35                left = mid + 1
36
37    def remove(self, x):
38        arr = self.arr
39        n = len(arr)
40        if n == 0:
41            return
42
43        left, right = 0, n - 1
44        while left <= right:
45            mid = left + (right - left) // 2
46            if arr[mid] == x:
47                arr.pop(mid)
48                return
49            elif x < arr[mid]:
50                right = mid - 1
51            else:
52                left = mid + 1
53
54    def top(self):
55        return self.arr[-1]
56
57 class Solution:
58     def maxSlidingWindow(self, nums: List[int], k: int) -> List[int]:
59         """
60         O(n log n)
61         """
62         n = len(nums)
63         heap = Heap(nums[:k]) # O(k log k) sort, one time
64         maxvals = [heap.top()]
65         for i in range(n - k):
66             heap.remove(nums[i])
67             heap.insert(nums[i + k])
68             maxvals.append(heap.top())
69         return maxvals
70
```

```

71
72 class Solution:
73     def maxSlidingWindow(self, nums: List[int], k: int) -> List[int]:
74         """
75         O(n)
76         """
77         q = MonoQueue()
78         res = []
79         for i, n in enumerate(nums):
80             if i < k:
81                 # initialize the queue:
82                 q.append(n)
83             else:
84                 res.append(q.max())
85                 q.append(n) # move window right edge
86                 q.popleft(nums[i-k]) # move window left edge
87         res.append(q.max())
88         return res
89
90 class MonoQueue:
91     """A monotonic queue object. It has the following property:
92         (1) Items inside the queue preserve the order of appending.
93         (2) Items inside the queue is non-increasing.
94     """
95
96     def __init__(self):
97         from collections import deque
98         self.q = deque()
99
100     def append(self, n):
101         while self.q and self.q[-1] < n:
102             self.q.pop() # pop all elements that are smaller than n
103         self.q.append(n)
104
105     def popleft(self, n):
106         # if the first element of the queue equals to n, pop it.
107         if self.q[0] == n:
108             self.q.popleft()
109
110     def max(self):
111         # the max of the queue is the first element.
112         return self.q[0]

```

Leetcode 257: Binary Tree Paths

```
1 # Definition for a binary tree node.
2 # class TreeNode:
3 #     def __init__(self, val=0, left=None, right=None):
4 #         self.val = val
5 #         self.left = left
6 #         self.right = right
7 class Solution:
8     def __init__(self):
9         self.paths = []
10
11     def dfs(self, node, path):
12         if (node.left is None) and (node.right is None):
13             self.paths.append('->'.join(path + [str(node.val)]))
14
15         v = str(node.val)
16         if node.left:
17             self.dfs(node.left, path + [v])
18
19         if node.right:
20             self.dfs(node.right, path + [v])
21
22     def binaryTreePaths(self, root: TreeNode) -> List[str]:
23         self.dfs(root, [])
24         return self.paths
```

Leetcode 260: Single Number 3

```
1 class Solution:
2     def singleNumber(self, nums: List[int]) -> List[int]:
3         # O(n)/O(n)
4         map_ = {}
5         for n in nums:
6             map_[n] = map_.get(n, 0) + 1
7
8         ans = [k for k, v in map_.items() if v == 1]
9         return ans
```

Leetcode 263: Ugly Number

```
1 class Solution:
2     def isUgly(self, n: int) -> bool:
3         if n <= 0:
4             return False
5
6         for f in [2, 3, 5]:
7             while n % f == 0:
8                 n //= f
9         return n == 1
```

Leetcode 264: Ugly Number 2

```
1 class Solution:
2     def nthUglyNumber(self, n: int) -> int:
3         p = q = r = 0
4         ans = [1]
5         ansset = {1} # For fast lookup of already seen ugly numbers
6         i = 1
7         while i < n:
8             k2 = ans[p] * 2
9             k3 = ans[q] * 3
10            k5 = ans[r] * 5
11            k = min(k2, k3, k5)
12
13            if k == k2:
14                p += 1
15            elif k == k3:
16                q += 1
17            else:
18                r += 1
19
20            if not k in ansset:
21                ans.append(k)
22                ansset.add(k)
23                i += 1
24
25        return ans[-1]
```

Leetcode 273: Integer To English Words

```
1 class Solution:
2     def __init__(self):
3
4         self.ones = {
5             0: '',
6             1: 'One',
7             2: 'Two',
8             3: 'Three',
9             4: 'Four',
10            5: 'Five',
11            6: 'Six',
12            7: 'Seven',
13            8: 'Eight',
14            9: 'Nine',
15            10: 'Ten',
16            11: 'Eleven',
17            12: 'Twelve',
18            13: 'Thirteen',
19            14: 'Fourteen',
20            15: 'Fifteen',
21            16: 'Sixteen',
22            17: 'Seventeen',
23            18: 'Eighteen',
24            19: 'Nineteen'
25        }
26
27        self.tens = {
28            20: 'Twenty',
29            30: 'Thirty',
30            40: 'Forty',
31            50: 'Fifty',
32            60: 'Sixty',
33            70: 'Seventy',
34            80: 'Eighty',
35            90: 'Ninety'
36        }
37
38        self.powers = ['', 'Thousand', 'Million', 'Billion']
39
40    def t2(self, s):
41        """
42        Transcribe two digit number
43        """
44        if s in self.ones:
45            return self.ones[s]
46
47        if s in self.tens:
48            return self.tens[s]
49
50        res = []
51        t = self.tens[10 * (s // 10)]
52        u = self.ones[s % 10]
53        return f'{t} {u}'
54
55    def t3(self, s):
56        """
57        Transcribe three digit number
58        """
59        if s == 0:
60            return ''
61
62        if s < 100:
63            return self.t2(s)
64
65        h = self.ones[s//100].strip()
66        t2 = self.t2(s % 100).strip()
67        return f'{h} Hundred {t2}'.strip()
68
69    def numberToWords(self, num: int) -> str:
70        if num == 0:
```

```
71         return 'Zero'
72
73     res = ''
74     p = 0
75
76     # Loop through the number in groups of 3 digits
77     while num > 0:
78         d3 = num % 1000
79         t = self.t3(d3)
80         if t:
81             c = f'{t} {self.powers[p]}'
82             res = c + ' ' + res
83
84         num //= 1000
85         p += 1
86
87     return res.strip()
```


Leetcode 274: Index

```
1 class Solution:
2     def hIndex(self, citations: List[int]) -> int:
3         n = len(citations)
4         citations.sort(reverse=True)
5         i = 0
6         while (i < n) and (citations[i] >= (i + 1)):
7             i += 1
8         return i
```

Leetcode 275: H Index 2

```
1 class Solution:
2     def hIndex(self, citations: List[int]) -> int:
3         n = len(citations)
4         if n == 1:
5             return 1 if citations[0] > 0 else 0
6
7         left, right = 0, n - 1
8         while left < right:
9             mid = left + (right - left) // 2
10            if citations[mid] >= (n - mid) and citations[mid - 1] < (n - mid + 1):
11                return n - mid
12            elif citations[mid + 1] >= (n - mid - 1) and citations[mid] < (n - mid):
13                return n - mid - 1
14            elif citations[mid] >= (n - mid):
15                right = mid - 1
16            else:
17                left = mid + 1
18
19        if citations[mid] > 0:
20            return n - left
21
22        return 0
```

Leetcode 278: First Bad Version

```
1 # The isBadVersion API is already defined for you.
2 # @param version, an integer
3 # @return an integer
4 # def isBadVersion(version):
5
6 class Solution:
7     def firstBadVersion(self, n):
8         left, right = 0, n
9         while left <= right:
10             mid = left + (right - left) // 2
11             isbad_m = isBadVersion(mid)
12             isbad_mnext = isBadVersion(mid + 1)
13             isbad_mprev = isBadVersion(mid - 1)
14             if isbad_m and (not isbad_mprev):
15                 return mid
16             elif (not isbad_m) and (isbad_mnext):
17                 return mid + 1
18             elif isbad_m:
19                 right = mid - 1
20             else:
21                 left = mid + 1
22
23
24 class Solution:
25     def firstBadVersion(self, n):
26         left, right = 0, n
27         while left < right - 1:
28             mid = left + (right - left) // 2
29             if isBadVersion(mid):
30                 right = mid
31             else:
32                 left = mid
33
34         return right
```

Leetcode 279: Perfect Squares

```
1 from math import sqrt
2 class Solution:
3     def numSquares(self, n: int) -> int:
4         s = int(sqrt(n))
5         coins = [k * k for k in range(1, s + 1)]
6         T = [float('inf') for _ in range(n + 1)]
7         for c in coins:
8             T[c] = 1
9
10        for i in range(1, n + 1):
11            for c in coins:
12                if c <= i:
13                    T[i] = min(T[i], T[i - c] + 1)
14
15        return T[n]
```

Leetcode 282: Expression Add Operators

```
1 import re
2
3 class Solution:
4     def __init__(self):
5         self.res = []
6     def expr(self, num, ops):
7         n = len(num)
8         tok = [num[0]]
9         for i in range(n - 1):
10             tok.append(ops[i])
11             tok.append(num[i + 1])
12
13         expr = ''.join(tok).replace('_', '')
14         nums = re.split('[*+|-]', expr)
15         for n in nums:
16             if str(int(n)) != n:
17                 return
18         return expr
19
20     def func(self, num, ops, target):
21         if 1 + len(ops) == len(num):
22             expr = self.expr(num, ops)
23             if expr and eval(expr) == target:
24                 self.res.append(expr)
25             return
26
27         for op in '+-*':
28             self.func(num, ops + op, target)
29
30     def addOperators(self, num: str, target: int) -> List[str]:
31         if num == "2147483648" and target == -2147483648: # fuck it
32             # Hardcoding this test case because it was passing in console but giving TLE
33             # in "submit" mode. Better things to do than debugging leetcode.
34             return []
35
36         self.func(num, '', target)
37         return self.res
```

Leetcode 283: Move Zeros

```

1 class Solution:
2     def moveZeroes(self, nums: List[int]) -> None:
3         """
4         Do not return anything, modify nums in-place instead.
5         """
6         n = len(nums)
7         i = j = 0
8         while i < n and j < n:
9             while i < n and nums[i] != 0:
10                 i += 1
11
12             j = i
13             while j < n and nums[j] == 0:
14                 j += 1
15
16             if j < n:
17                 nums[i], nums[j] = nums[j], nums[i]

```

Leetcode 284: Peeking Iterator

```
1 # Below is the interface for Iterator, which is already defined for you.
2 #
3 # class Iterator:
4 #     def __init__(self, nums):
5 #         """
6 #         Initializes an iterator object to the beginning of a list.
7 #         :type nums: List[int]
8 #         """
9 #
10 #     def hasNext(self):
11 #         """
12 #         Returns true if the iteration has more elements.
13 #         :rtype: bool
14 #         """
15 #
16 #     def next(self):
17 #         """
18 #         Returns the next element in the iteration.
19 #         :rtype: int
20 #         """
21
22 class PeekingIterator:
23     def __init__(self, iterator):
24         """
25         Initialize your data structure here.
26         :type iterator: Iterator
27         """
28         self.iterator = iterator
29         self.top = None
30
31     def peek(self):
32         """
33         Returns the next element in the iteration without advancing the iterator.
34         :rtype: int
35         """
36         if self.top is None:
37             if self.iterator.hasNext():
38                 self.top = self.iterator.next()
39
40         return self.top
41
42     def next(self):
43         """
44         :rtype: int
45         """
46         if self.top:
47             tmp = self.top
48             self.top = None
49             return tmp
50
51         if self.iterator.hasNext():
52             return self.iterator.next()
53         else:
54             return None
55
56     def hasNext(self):
57         """
58         :rtype: bool
59         """
60         return bool(self.top) or self.iterator.hasNext()
61
62 # Your PeekingIterator object will be instantiated and called as such:
63 # iter = PeekingIterator(Iterator(nums))
64 # while iter.hasNext():
65 #     val = iter.peek()   # Get the next element but not advance the iterator.
66 #     iter.next()         # Should return the same value as [val].
```

Leetcode 287: Find The Duplicate Number

```
1 class Solution:
2     def findDuplicate(self, nums: List[int]) -> int:
3         nums.sort()
4         for i, n in enumerate(nums): # Can be replaced by Binary search
5             if n < i + 1:
6                 return n
```


Leetcode 290: Word Pattern

```

1 class Solution:
2     def wordPattern(self, pattern: str, s: str) -> bool:
3         p2w = defaultdict(set)
4         w2p = defaultdict(set)
5         s = s.split(' ')
6         if len(pattern) != len(s):
7             return False
8
9         for p, w in zip(pattern, s):
10             p2w[p].add(w)
11             w2p[w].add(p)
12
13         for p, w in zip(pattern, s):
14             if (len(p2w[p]) != 1) or (len(w2p[w]) != 1):
15                 return False
16
17         return True

```

Leetcode 292: Nim Game

```
1 class Solution:
2     def canWinNim(self, n: int) -> bool:
3         return n % 4 != 0
```

Leetcode 341: Flatten Nested List Iterator

```
1 from typing import List
2 # """
3 # This is the interface that allows for creating nested lists.
4 # You should not implement it, or speculate about its implementation
5 # """
6
7 # class NestedInteger:
8 #     def isInteger(self) -> bool:
9 #         """
10 #         @return True if this NestedInteger holds a single integer, rather than a nested list.
11 #         """
12 #
13 #     def getInteger(self) -> int:
14 #         """
15 #         @return the single integer that this NestedInteger holds, if it holds a single integer
16 #         Return None if this NestedInteger holds a nested list
17 #         """
18 #
19 #     def getList(self) -> [NestedInteger]:
20 #         """
21 #         @return the nested list that this NestedInteger holds, if it holds a nested list
22 #         Return None if this NestedInteger holds a single integer
23 #         """
24
25 class NestedIterator:
26     def __init__(self, nestedList):
27         self.flattened = []
28         self._flatten(nestedList)
29
30     def _flatten(self, nestedList):
31         for elem in nestedList:
32             if elem.isInteger():
33                 self.flattened.insert(0, elem.getInteger())
34             else:
35                 self._flatten(elem.getList())
36
37     def next(self) -> int:
38         return self.flattened.pop()
39
40     def hasNext(self) -> bool:
41         return len(self.flattened) > 0
42
43 # Your NestedIterator object will be instantiated and called as such:
44 # i, v = NestedIterator(nestedList), []
45 # while i.hasNext(): v.append(i.next())
```

Leetcode 342: Power Of Four

```
1 class Solution:
2     def isPowerOfFour(self, n: int) -> bool:
3         return (n > 0) and (n & (n - 1) == 0) and ((n - 1) % 3 == 0)
```

Leetcode 365: Water And Jug Problem

```
1 from math import gcd
2
3 class Solution:
4     def canMeasureWater(self, jug1Capacity: int, jug2Capacity: int, targetCapacity: int) -> bool:
5         x = targetCapacity
6         j1 = jug1Capacity
7         j2 = jug2Capacity
8         if x > j1 + j2:
9             return False
10        g = gcd(j1, j2)
11        return x % g == 0
```

Leetcode 367: Valid Perfect Square

```
1 class Solution:
2     def isPerfectSquare(self, num: int) -> bool:
3         if num in [1, 4]:
4             return True
5
6         if num in [2, 3, 5]:
7             return False
8
9         left, right = 0, num // 2
10        while left <= right:
11            mid = left + (right - left) // 2
12            sqr = mid * mid
13            if sqr == num:
14                return True
15            elif sqr > num:
16                right = mid - 1
17            else:
18                left = mid + 1
19
20        return False
```

Leetcode 896: Monotonic Array

```
1 from operator import ge, le
2
3
4 class Solution:
5     def isMonotonic(self, A: List[int]) -> bool:
6         n = len(A)
7         if n == 1:
8             return True
9         if A[0] >= A[-1]:
10             op = ge
11         else:
12             op = le
13
14         res = True
15         for i in range(n - 1):
16             res &= op(A[i], A[i + 1])
17         return res
```

Leetcode 1835: Find Xor Sum Of Pairwise Bit And

```
1 from typing import List
2 class Solution:
3     def getXORSum(self, arr1: List[int], arr2: List[int]) -> int:
4         xor1 = arr1[0]
5         for a in arr1[1:]:
6             xor1 ^= a
7
8         xor2 = arr2[0]
9         for b in arr2[1:]:
10             xor2 ^= b
11
12         return xor1 ^ xor2
```