283	Move Zeroes	49.2%

Copy non-zeros to the beginning, and then insert zeroes at the end.

325	Maximum Size Subarray Sum Equals k	42.1

Hash table of (sum(0,end_index), end_index), look for curr_sum-target in hash table.

301	Remove Invalid Parentheses	35.0%

1. BFS on number of parentheses removed with visited hash set and linked list queue. Check if each is valid.
2. Calculate # removable left/right parenthesis and count # open parenthesis to avoid invalid string. DFS on each char from left that either use it or not use it if it is parenthesis (o.t. append it).

```
if (c == '(') {
        dfs(s, i + 1, res, sb, rmL - 1, rmR, open);              // not use (
        dfs(s, i + 1, res, sb.append(c), rmL, rmR);       // use (

    } else if (c == ')') {
        dfs(s, i + 1, res, sb, rmL, rmR - 1, open);               // not use
 )
        dfs(s, i + 1, res, sb.append(c), rmL, rmR, open - 1);            // us
e )

    } else {
        dfs(s, i + 1, res, sb.append(c), rmL, rmR, open);
    }
```

67	Add Binary	31.6%

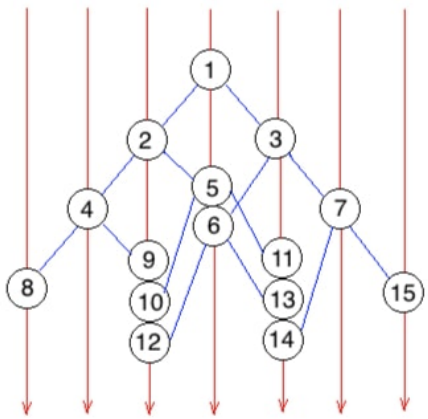
Start from right to left bitwise.
Sum = a + b + carry
sb.append(Integer.toString(sum & 1));
carry = (sum >> 1) ;

311	Sparse Matrix Multiplication	50.6%

A sparse matrix can be represented as a sequence of rows, each of which is a sequence of (column-number, value) pairs of the nonzero values in the row.

```
for(int i = 0; i < m; i++) {
            for(int k = 0; k < n; k++) {
                if (A[i][k] != 0) {
                    for (int j = 0; j < nB; j++) {
                        if (B[k][j] != 0) C[i][j] += A[i][k] * B[k][j];
                    }
                }
            }
        }
```

314	Binary Tree Vertical Order Traversal	36.1%



BFS instead of DFS to keep order of each list (downwards). Keep queue of both nodes and column # corresponded.

```
        map.get(col).add(node.val);
        if (node.left != null) {
            q.add(node.left);
            cols.add(col - 1);
            min = Math.min(min, col - 1);
        }

        if (node.right != null) {
            q.add(node.right);
            cols.add(col + 1);
            max = Math.max(max, col + 1);
        }
```

273	Integer to English Words	21.7%

1. Index array instead of if statements

```
private final String[] LESS_THAN_20 = {"", "One", "Two", "Three", "Four", "Fi
ve", "Six", "Seven", "Eight", "Nine", "Ten", "Eleven", "Twelve", "Thirteen",
"Fourteen", "Fifteen", "Sixteen", "Seventeen", "Eighteen", "Nineteen"};
private final String[] TENS = {"", "Ten", "Twenty", "Thirty", "Forty", "Fifty
", "Sixty", "Seventy", "Eighty", "Ninety"};
private final String[] THOUSANDS = {"", "Thousand", "Million", "Billion"};
```

2. Handle piece of length 3 (num%1000, num \=1000)

```
if (num == 0)
        return "";
    else if (num < 20)
        return LESS_THAN_20[num] + " ";
    else if (num < 100)
        return TENS[num / 10] + " " + helper(num % 10);
    else
        return LESS_THAN_20[num / 100] + " Hundred " + helper(num % 100);
```

7	Letter Combinations of a Phone Number	33.7%	Medium

1. Iterative (BFS)
   For each digit added, remove and copy every element in the queue and add the possible letter to each element, then add the updated elements back into queue again. Repeat this procedure until all the digits are iterated.

```
for(int i =0; i<digits.length();i++){
        int x = Character.getNumericValue(digits.charAt(i));
        while(ans.peek().length()==i){
            String t = ans.remove();
            for(char s : mapping[x].toCharArray())
                ans.add(t+s);
        }
    }
```

2. Recursive (DFS)

```
private void combination(String prefix, String digits, int offset, L
ist<String> ret)
```

```
            if (offset >= digits.length()) {
                ret.add(prefix);
                return;
            }
            String letters = KEYS[(digits.charAt(offset) - '0')];
            for (int i = 0; i < letters.length(); i++) {
                combination(prefix + letters.charAt(i), digits, offset
+ 1, ret);
            }
```

278	First Bad Version	24.9%

Binary Search

1. Recursive

```
if (isBadVersion(middle)) {
        if (!isBadVersion(middle-1)) {
            return middle;
        }

        return binarySearch(start,middle-1);
    } else {

        return binarySearch(middle + 1,
end);
    }
```

2. Iterative

```
int start = 1, end = n;
while (start <= end) {
    int mid = start + (end-start) / 2;
```

```
int start = 0;
int end = inputArr.length - 1;
while (start <= end) {
    int mid = (start + end) / 2;
    if (key == inputArr[mid]) {
        return mid;
    }
    if (key < inputArr[mid]) {
        end = mid - 1;
    } else {
        start = mid + 1;
    }
}
```

```
public static int binarySearch(int[] a, int start, int end, int target) {
    int middle = (start + end) / 2;
    if(end < start) {
        return -1;
    }

    if(target==a[middle]) {
        return middle;
    } else if(target<a[middle]) {
        return binarySearch(a, start, middle - 1, target);
    } else {
        return binarySearch(a, middle + 1, end, target);
    }
}
```

```
    if (!isBadVersion(mid)) start = mid + 1;
    else end = mid-1;
  }
  return start;
```

91	Decode Ways	19.3%

DP from start to end:
Base: string of len 0 has 1 decode way.
String of len 1 has 1 way if first char is not 0.
Recursive: current digit i is 1-9
Dp[i]+=dp[i-1]
Number [i-1,i] is valid (10-26)
Dp[i]+=dp[i-2]

```
int[] dp = new int[n+1];
dp[0] = 1;
dp[1] = s.charAt(0) != '0' ? 1 : 0;
for(int i = 2; i <= n; i++) {
    int first = Integer.valueOf(s.substring(i-1, i));
    int second = Integer.valueOf(s.substring(i-2, i));
    if(first >= 1 && first <= 9) {
       dp[i] += dp[i-1];
    }
    if(second >= 10 && second <= 26) {
        dp[i] += dp[i-2];
    }
}
return dp[n];
```

253	Meeting Rooms II	38.7%

```
Arrays.sort(intervals, new Comparator<Interval>() {
  public int compare(Interval a, Interval b) { return a.start - b.start; }
});
```

1. Min heap
   Sort the intervals based on starting time of events.
   Keep a min heap based on ending time of events.
   ```
   if (intervals[i].start >= ends.peek()) {
   // no overlap, then should poll out and update smallest end.
          ends.poll();
   }
   // Add the merged interval or only the new required interval.
   ends.offer(intervals[i].end);
   return ends.size();
   ```
2. Event queue: Event class with start, end, type.
   Sort the start/end events together and process increasingly.
   Count the depth (depth ++ when start, depth-- when ends), Record max depth

10	Regular Expression Matching	24.0%

1, If p.charAt(j) == s.charAt(i) : dp[i][j] = dp[i-1][j-1];
2, If p.charAt(j) == '.' : dp[i][j] = dp[i-1][j-1];
3, If p.charAt(j) == '*':
here are two sub conditions:
1 if p.charAt(j-1) != s.charAt(i) : dp[i][j] = dp[i][j-2]
//in this case, a* only counts as empty
2 if p.charAt(i-1) == s.charAt(i) or p.charAt(i-1) == '.':
dp[i][j] = dp[i-1][j] //in this case, a* counts as multiple a

or dp[i][j] = dp[i][j-1] // in this case, a* counts as single a
or dp[i][j] = dp[i][j-2] // in this case, a* counts as empty

15	3Sum	21.5%	Medium

O(n^2): for each possible first triplet, do two sum.

```
    for (int i = 0; i < num.length-2; i++) {
        if (i == 0 || (i > 0 && num[i] != num[i-1])) {
            int lo = i+1, hi = num.length-1, sum = 0 - num[i];
            while (lo < hi) {
                if (num[lo] + num[hi] == sum) {
                    res.add(Arrays.asList(num[i], num[lo], num[hi]));
                    while (lo < hi && num[lo] == num[lo+1]) lo++;
                    while (lo < hi && num[hi] == num[hi-1]) hi--;
                    lo++; hi--;
                } else if (num[lo] + num[hi] < sum) lo++;
                else hi--;
           }
        }
    }
```

277	Find the Celebrity	35.3%

The definition of a celebrity is that all the other `n - 1` people know him/her but he/she does not know any of them.

1. Iterative compare the person with candidate, switch candidate if knows(candidate,i).
2. Check if the potential candidate is real.

   suppose the candidate after the first `for` loop is person `k`, it means `0` to `k-1` cannot be the celebrity, because they know a previous or current candidate. Also, since `k` knows no one between `k+1` and `n-1`, `k+1` to `n-1` can not be the celebrity either. Therefore, `k` is the only possible celebrity, if there exists one.

```
int candidate = 0;
        for(int i = 1; i < n; i++){
            if(knows(candidate, i))
                candidate = i;
        }
        for(int i = 0; i < n; i++){
            if(i != candidate && (knows(candidate, i) || !knows(i, candidat
e))) return -1;
        }
        return candidate;
```

157	Read N Characters Given Read4	29.0%

The API: `int read4(char *buf)` reads 4 characters at a time from a file.
it returns 3 if there is only 3 characters left in the file.
implement the function `int read(char *buf, int n)` that reads *n* characters from the file.
Key is to determine how many bits to copy from read buf to our buffer. Math.min()

```
while (!eof && total < n) {
    int count = read4(tmp);

    // check if it's the end of the file
    eof = count < 4;

    // get the actual count
    count = Math.min(count, n - total);

    // copy from temp buffer to buf
    for (int i = 0; i < count; i++)
      buf[total++] = tmp[i];
  }

  return total;
```

158	Read N Characters Given Read4 II - Call multiple times

Keep global variables to store previous read records.

```
private int buffPtr = 0; //stores the previous position copied to buffer
private int buffCnt = 0; //stores the previous position read by API
private char[] buff = new char[4]; //stores the last buff read
public int read(char[] buf, int n) {
    int ptr = 0;
    while (ptr < n) {
        if (buffPtr == 0) {
            buffCnt = read4(buff);
        }
        while (ptr < n && buffPtr < buffCnt) {
            buf[ptr++] = buff[buffPtr++];
        }
        // all chars in buff used up, set pointer to 0
        if (buffPtr == buffCnt) buffPtr = 0;
        // read4 returns less than 4, end of file
        if (buffCnt < 4) break;
    }
    return ptr;
}
```

297	Serialize and Deserialize Binary Tree

Recursively build the string from tree or reversely.

```
public class Codec {
    private static final String spliter = ",";
    private static final String NN = "X";

    // Encodes a tree to a single string.
    public String serialize(TreeNode root) {
        StringBuilder sb = new StringBuilder();
        buildString(root, sb);
        return sb.toString();
    }
```

```
    private void buildString(TreeNode node, StringBuilder sb) {
        if (node == null) {
            sb.append(NN).append(spliter);
        } else {
            sb.append(node.val).append(spliter);
            buildString(node.left, sb);
            buildString(node.right,sb);
        }
    }
    // Decodes your encoded data to tree.
    public TreeNode deserialize(String data) {
        Deque<String> nodes = new LinkedList<>();
        nodes.addAll(Arrays.asList(data.split(spliter)));
        return buildTree(nodes);
    }

    private TreeNode buildTree(Deque<String> nodes) {
        String val = nodes.remove();
        if (val.equals(NN)) return null;
        else {
            TreeNode node = new TreeNode(Integer.valueOf(val));
            node.left = buildTree(nodes);
            node.right = buildTree(nodes);
            return node;
        }
    }
}
```

200	Number of Islands	33.8%

Example 1: `'1'`s (land) and `'0'`s (water),

```
11110
11010
11000
00000
```

Answer: 1

Example 2:

```
11000
11000
00100
00011
```

Answer: 3

For each island, DFS from it towards 4 directions and mark them as 0. Sink the islands next to each other and increment only once.

```java
    int y;          // The height of the given grid
    int x;          // The width of the given grid
    char[][] g;     // The given grid, stored to reduce recursion memory usag
e

    /**
     * Given a 2d grid map of '1's (land) and '0's (water),
     * count the number of islands.
     *
     * This method approaches the problem as one of depth-first connected
     * components search
     * @param grid, the given grid.
     * @return the number of islands.
     */
    public int numIslands(char[][] grid) {
        // Store the given grid
        // This prevents having to make copies during recursion
        g = grid;

        // Our count to return
        int c = 0;

        // Dimensions of the given graph
        y = g.length;
        if (y == 0) return 0;
        x = g[0].length;

        // Iterate over the entire given grid
        for (int i = 0; i < y; i++) {
            for (int j = 0; j < x; j++) {
                if (g[i][j] == '1') {
                    dfs(i, j);
                    c++;
                }
            }
        }
        return c;
    }

    /**
     * Marks the given site as visited, then checks adjacent sites.
     *
     * Or, Marks the given site as water, if land, then checks adjacent site
s.
     *
     * Or, Given one coordinate (i,j) of an island, obliterates the island
     * from the given grid, so that it is not counted again.
     *
     * @param i, the row index of the given grid
     * @param j, the column index of the given grid
     */
    private void dfs(int i, int j) {

        // Check for invalid indices and for sites that aren't land
        if (i < 0 || i >= y || j < 0 || j >= x || g[i][j] != '1') return;
```

```
        // Mark the site as visited
        g[i][j] = '0';

        // Check all adjacent sites
        dfs(i + 1, j);
        dfs(i - 1, j);
        dfs(i, j + 1);
        dfs(i, j - 1);
    }
```

---

282 Expression Add Operators 29.3%

Examples:

```
"123", 6 -> ["1+2+3", "1*2*3"]
"232", 8 -> ["2*3+2", "2+3*2"]
"105", 5 -> ["1*0+5","10-5"]
"00", 0 -> ["0+0", "0-0", "0*0"]
"3456237490", 9191 -> []
```

Backtracking with state params: current incrementing path, length, left (cur eval result), cur (cur expression), pos (position of digits array).

```
void dfs(List<String> ret, char[] path, int len, long left, long cur, char[]
digits, int pos, int target) {
    if (pos == digits.length) {
        if (left + cur == target) ret.add(new String(path, 0, len));
        return;
    }
    long n = 0;
    int j = len + 1;
    for (int i = pos; i < digits.length; i++) {
        n = n * 10 + digits[i] - '0';
        path[j++] = digits[i];
        path[len] = '+';
        dfs(ret, path, j, left + cur, n, digits, i + 1, target);
        path[len] = '-';
        dfs(ret, path, j, left + cur, -n, digits, i + 1, target);
        path[len] = '*';
        dfs(ret, path, j, left, cur * n, digits, i + 1, target);
        if (digits[pos] == '0') break;
    }
}
public List<String> addOperators(String num, int target) {
    List<String> ret = new LinkedList<>();
    if (num.length() == 0) return ret;
    char[] path = new char[num.length() * 2 - 1];
```

```
    char[] digits = num.toCharArray();
    long n = 0;
    for (int i = 0; i < digits.length; i++) {
        n = n * 10 + digits[i] - '0';
        path[i] = digits[i];
        dfs(ret, path, i + 1, 0, n, digits, i + 1, target);
        if (n == 0) break;
    }
    return ret;
}
```

76	Minimum Window Substring	24.7%

For example,
S = `"ADOBECODEBANC"`
T = `"ABC"`

Minimum window is `"BANC"`.

```
if(S.empty() || T.empty()){
    return result;
}
unordered_map<char, int> map;
unordered_map<char, int> window;
for(int i = 0; i < T.length(); i++){
    map[T[i]]++;
}
int minLength = INT_MAX;
int letterCounter = 0;
for(int slow = 0, fast = 0; fast < S.length(); fast++){
    char c = S[fast];
    if(map.find(c) != map.end()){
        window[c]++;
        if(window[c] <= map[c]){
            letterCounter++;
        }
    }
    if(letterCounter >= T.length()){
        while(map.find(S[slow]) == map.end() || window[S[slow]] > map[S[slo
w]]){
            window[S[slow]]--;
            slow++;
        }
        if(fast - slow + 1 < minLength){
            minLength = fast - slow + 1;
            result = S.substr(slow, minLength);
        }
        // shrink the window here
        window[S[slow]]--;
        slow++;
        letterCounter--;
    }
}
```

```
return result;
```

257	Binary Tree Paths	37.3%

```
public List<String> binaryTreePaths(TreeNode root) {
    List<String> answer = new ArrayList<String>();
    if (root != null) searchBT(root, "", answer);
    return answer;
}
private void searchBT(TreeNode root, String path, List<String> answer) {
    if (root.left == null && root.right == null) answer.add(path + root.val);
    if (root.left != null) searchBT(root.left, path + root.val + "->", answe
r);
    if (root.right != null) searchBT(root.right, path + root.val + "->", answ
er);
}
```

23	Merge k Sorted Lists	26.8%

1. Priority queue

```
public class Solution {
    public ListNode mergeKLists(List<ListNode> lists) {
        if (lists==null||lists.size()==0) return null;

        PriorityQueue<ListNode> queue= new PriorityQueue<ListNode>(lists.size
(),new Comparator<ListNode>(){
            @Override
            public int compare(ListNode o1,ListNode o2){
                if (o1.val<o2.val)
                    return -1;
                else if (o1.val==o2.val)
                    return 0;
                else
                    return 1;
            }
        });

        ListNode dummy = new ListNode(0);
        ListNode tail=dummy;

        for (ListNode node:lists)
            if (node!=null)
                queue.add(node);

        while (!queue.isEmpty()){
            tail.next=queue.poll();
            tail=tail.next;

            if (tail.next!=null)
                queue.add(tail.next);
```

```
        }
        return dummy.next;
    }
}
```

2.Binary Search

```
public class Solution {
    public ListNode mergeTwoLists(ListNode l1, ListNode l2) {
        if (l1 == null) return l2;
        if (l2 == null) return l1;

        ListNode head=null;
        ListNode former=null;
        while (l1!=null&&l2!=null) {
            if (l1.val>l2.val) {
                if (former==null) former=l2; else former.next=l2;
                if (head==null) head=former; else former=former.next;
                l2=l2.next;
            } else {
                if (former==null) former=l1; else former.next=l1;
                if (head==null) head=former; else former=former.next;
                l1=l1.next;
            }
        }
        if (l2!=null) l1=l2;
        former.next=l1;
        return head;

    }

    public ListNode mergeKLists(List<ListNode> lists) {
        if (lists.size()==0) return null;
        if (lists.size()==1) return lists.get(0);
        if (lists.size()==2) return mergeTwoLists(lists.get(0), lists.get
(1));
        return mergeTwoLists(mergeKLists(lists.subList(0, lists.size()/2)),
            mergeKLists(lists.subList(lists.size()/2, lists.size())));
    }
}
```

101. Symmetric Tree

```
    1
   / \
  2   2
 / \ / \
3  4 4  3
```

```
public boolean isSymmetric(TreeNode root) {
    if(root==null) return true;
    return isMirror(root.left,root.right);
}
public boolean isMirror(TreeNode p, TreeNode q) {
    if(p==null && q==null) return true;
    if(p==null || q==null) return false;
    return (p.val==q.val) && isMirror(p.left,q.right) && isMirror(p.right,q.l
eft);
}
```

543	Diameter of Binary Tree	42.8%

```
public class Solution {
    int max;
    public int diameterOfBinaryTree(TreeNode root) {
        max = 0;
        height(root);
        return max;
    }
    int height(TreeNode root){
        if(root==null)return -1;
        int leftH = height(root.left);
        int rightH = height(root.right);
        int height = Math.max(leftH,rightH)+1;
        max = Math.max(max,leftH+rightH+2);
        return height;
    }
}
```

572	Subtree of Another Tree	42.1%

```
public class Solution {
    public boolean isSubtree(TreeNode s, TreeNode t) {
        if (s == null) return false;
        if (isSame(s, t)) return true;
        return isSubtree(s.left, t) || isSubtree(s.right, t);
    }

    private boolean isSame(TreeNode s, TreeNode t) {
        if (s == null && t == null) return true;
        if (s == null || t == null) return false;

        if (s.val != t.val) return false;

        return isSame(s.left, t.left) && isSame(s.right, t.right);
    }
}
```

581. Shortest Unsorted Continuous Subarray

```
public int findUnsortedSubarray(int[] A) {
    int n = A.length, beg = -1, end = -2, min = A[n-1], max = A[0];
    for (int i=1;i<n;i++) {
      max = Math.max(max, A[i]);
      min = Math.min(min, A[n-1-i]);
      if (A[i] < max) end = i;
      if (A[n-1-i] > min) beg = n-1-i;
    }
    return end - beg + 1;
}
```

26	Remove Duplicates from Sorted Array	35.5

```
class Solution {
    public:
    int removeDuplicates(int A[], int n) {
        if(n < 2) return n;
        int id = 1;
        for(int i = 1; i < n; ++i)
            if(A[i] != A[i-1]) A[id++] = A[i];
        return id;
    }
};
```

168	Excel Sheet Column Title	25.5%

```
public class Solution {
   public String convertToTitle(int n) {
      String res = "";
       while(n>0){
         n--;
          res = (char)(n%26+'A')+res;
         n = n/26;
      }
      return res;
   }
}
```

161	One Edit Distance	31.0%

1. Find the first char that is different in s and t.
2. Delete (from s or t)/Replace (in s or t) and determine the equality of the rest of the string.

```
public boolean isOneEditDistance(String s, String t) {
    for (int i = 0; i < Math.min(s.length(), t.length()); i++) {
        if (s.charAt(i) != t.charAt(i)) {
                if (s.length() == t.length()) // s has the same length as t, s
o the only possibility is replacing one char in s and t
                    return s.substring(i + 1).equals(t.substring(i + 1));
```

```
                        else if (s.length() < t.length()) // t is longer than
s, so the only possibility is deleting one char from t
                                return s.substring(i).equals(t.substring(i +
1));
                        else // s is longer than t, so the only possibility is
 deleting one char from s
                                return t.substring(i).equals(s.substring(i +
1));
        }
    }
    //All previous chars are the same, the only possibility is deleting the e
nd char in the longer one of s and t
    return Math.abs(s.length() - t.length()) == 1;
}
```

285	Inorder Successor in BST	36.0%

1. Iterative

```
public TreeNode inorderSuccessor(TreeNode root, TreeNode p) {
    TreeNode res = null;
    while(root!=null) {
        if(root.val > p.val) {
                res = root;
                root = root.left;
        }
        else root = root.right;
    }
    return res;
}

public TreeNode inorderPredecessor (TreeNode root, TreeNode p) {
    TreeNode pre = null;
    while(root!=null) {
        if(root.val < p.val) {
                pre = root;
                root = root.right;
        }
        else root = root.left;
    }
    return pre;
}
```

2. Recursive

Successor

```
public TreeNode successor(TreeNode root, TreeNode p) {
  if (root == null)
    return null;

  if (root.val <= p.val) {
    return successor(root.right, p);
  } else {
    TreeNode left = successor(root.left, p);
    return (left != null) ? left : root;
```

```
  }
}
```

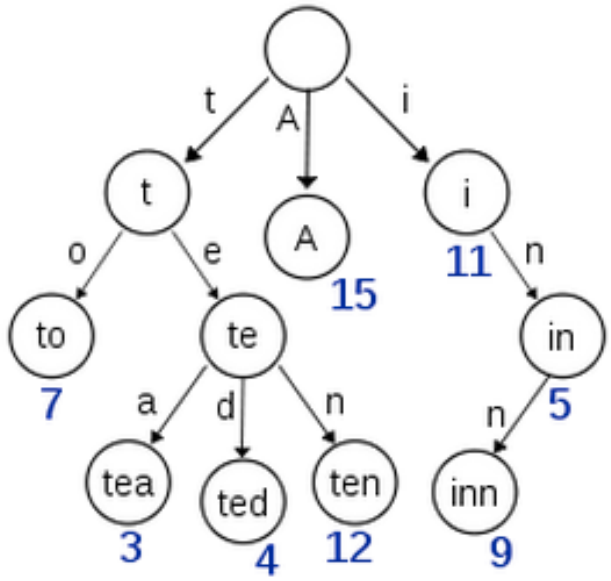
Predecessor

```
public TreeNode predecessor(TreeNode root, TreeNode p) {
  if (root == null)
    return null;

  if (root.val >= p.val) {
    return predecessor(root.left, p);
  } else {
    TreeNode right = predecessor(root.right, p);
    return (right != null) ? right : root;
  }
}
```

211	Add and Search Word - Data structure design	21.9

208. Implement Trie (Prefix Tree)



Use an array of length 26 to represent hash map of a-z as children set of a given node.
Have a isWord flag for each node (maybe only prefix of some word).

```
class TrieNode {
    public char val;
    public boolean isWord;
    public TrieNode[] children = new TrieNode[26];
    public TrieNode() {}
    TrieNode(char c){
        TrieNode node = new TrieNode();
        node.val = c;
    }
}
```

```java
public class Trie {
    private TrieNode root;
    public Trie() {
        root = new TrieNode();
        root.val = ' ';
    }

    public void insert(String word) {
        TrieNode ws = root;
        for(int i = 0; i < word.length(); i++){
            char c = word.charAt(i);
            if(ws.children[c - 'a'] == null){
                ws.children[c - 'a'] = new TrieNode(c);
            }
            ws = ws.children[c - 'a'];
        }
        ws.isWord = true;
    }

    public boolean search(String word) {
        TrieNode ws = root;
        for(int i = 0; i < word.length(); i++){
            char c = word.charAt(i);
            if(ws.children[c - 'a'] == null) return false;
            ws = ws.children[c - 'a'];
        }
        return ws.isWord;
    }

    public boolean startsWith(String prefix) {
        TrieNode ws = root;
        for(int i = 0; i < prefix.length(); i++){
            char c = prefix.charAt(i);
            if(ws.children[c - 'a'] == null) return false;
            ws = ws.children[c - 'a'];
        }
        return true;
    }
}
```

Regular expression with “.”

```java
    public boolean search(String word) {
        return helper(word, 0, root);
    }

    private boolean helper(String s, int index, TrieNode p) {
        if (index >= s.length()) return p.isWord;
        char c = s.charAt(index);
        if (c == '.') {
            for (int i = 0; i < p.child.length; i++)
                if (p.child[i] != null && helper(s, index + 1, p.child[i]))
                    return true;
            return false;
```

```
        } else return (p.child[c - 'a'] != null && helper(s, index + 1, p.chi
ld[c - 'a']));
    }
```

121	Best Time to Buy and Sell Stock	40

1. Keep the min price, max profit sold at day i, max of max profit.

```
public class Solution {
   public int maxProfit(int[] prices) {
      if(prices.length ==0)
         return 0;
      int min = prices[0];
      int max_profit = -1;
      for(int price:prices){
         min = Math.min(min,price);
         max_profit = Math.max(max_profit, price-min);
      }
      return max_profit;
   }
}
```

2. If the array is difference of prices, keep

```
public class Solution {
   public int maxProfit(int[] prices) {
      int maxCur = 0, maxSoFar = 0;
      for(int i = 1; i < prices.length; i++) {
         maxCur = Math.max(prices[i] - prices[i-1], maxCur+ prices[i] - prices[i-1]);
          //include ending at i-1 or not
         maxSoFar = Math.max(maxCur, maxSoFar);
      }
      return maxSoFar;
   }
}
```

492. Construct the Rectangle

```
public int[] constructRectangle(int area) {
        int w = (int)Math.sqrt(area);
        while (area%w!=0) w--;
        return new int[]{area/w, w};
}
```

39. Combination Sum

Given a **set** of candidate numbers (***C***) **(without duplicates)** and a target number (***T***), find all unique combinations in ***C*** where the candidate numbers sums to ***T***.

The **same** repeated number may be chosen from ***C*** unlimited number of times.

```
public List<List<Integer>> combinationSum(int[] nums, int target) {
    List<List<Integer>> list = new ArrayList<>();
    Arrays.sort(nums);
    backtrack(list, new ArrayList<>(), nums, target, 0);
    return list;
}

private void backtrack(List<List<Integer>> list, List<Integer> tempList, int
[] nums, int remain, int start){
    if(remain < 0) return;
    else if(remain == 0) list.add(new ArrayList<>(tempList));
    else{
        for(int i = start; i < nums.length && nums[i]<=remain; i++){ //prune
            tempList.add(nums[i]);
            backtrack(list, tempList, nums, remain - nums[i], i); // not i +
1 because we can reuse same elements
            tempList.remove(tempList.size() - 1);
        }
    }
}
```

40. Combination Sum II

Given a collection of candidate numbers (***C***) and a target number (***T***), find all unique combinations

in ***C*** where the candidate numbers sums to ***T***.

Each number in ***C*** may only be used **once** in the combination.

```
public List<List<Integer>> combinationSum2(int[] nums, int target) {
    List<List<Integer>> list = new ArrayList<>();
    Arrays.sort(nums);
    backtrack(list, new ArrayList<>(), nums, target, 0);
    return list;

}

private void backtrack(List<List<Integer>> list, List<Integer> tempList, int
[] nums, int remain, int start){
    if(remain < 0) return;
    else if(remain == 0) list.add(new ArrayList<>(tempList));
    else{
        for(int i = start; i < nums.length; i++){
            if(i > start && nums[i] == nums[i-1]) continue; // skip duplicate
s
            tempList.add(nums[i]);
            backtrack(list, tempList, nums, remain - nums[i], i + 1);
```

```
            tempList.remove(tempList.size() - 1);
        }
    }
}
```

78. Subsets

```
public List<List<Integer>> subsets(int[] nums) {
    List<List<Integer>> list = new ArrayList<>();
    Arrays.sort(nums);
    backtrack(list, new ArrayList<>(), nums, 0);
    return list;
}

private void backtrack(List<List<Integer>> list , List<Integer> tempList, int
 [] nums, int start){
    list.add(new ArrayList<>(tempList));
    for(int i = start; i < nums.length; i++){
        tempList.add(nums[i]);
        backtrack(list, tempList, nums, i + 1);
        tempList.remove(tempList.size() - 1);
    }
}
```

Subsets II (contains duplicates) : https://leetcode.com/problems/subsets-ii/

```
public List<List<Integer>> subsetsWithDup(int[] nums) {
    List<List<Integer>> list = new ArrayList<>();
    Arrays.sort(nums);
    backtrack(list, new ArrayList<>(), nums, 0);
    return list;
}

private void backtrack(List<List<Integer>> list, List<Integer> tempList, int
[] nums, int start){
    list.add(new ArrayList<>(tempList));
    for(int i = start; i < nums.length; i++){
        if(i > start && nums[i] == nums[i-1]) continue; // skip duplicates
        tempList.add(nums[i]);
        backtrack(list, tempList, nums, i + 1);
        tempList.remove(tempList.size() - 1);
    }
}
```

46. Permutations

Given a collection of **distinct** numbers, return all possible permutations.

```
public List<List<Integer>> permute(int[] nums) {
   List<List<Integer>> list = new ArrayList<>();
   // Arrays.sort(nums); // not necessary
   backtrack(list, new ArrayList<>(), nums);
   return list;
}

private void backtrack(List<List<Integer>> list, List<Integer> tempList, int
[] nums){
```

```
   if(tempList.size() == nums.length){
      list.add(new ArrayList<>(tempList));
   } else{
      for(int i = 0; i < nums.length; i++){
         if(tempList.contains(nums[i])) continue; // element already exists, skip
         tempList.add(nums[i]);
         backtrack(list, tempList, nums);
         tempList.remove(tempList.size() - 1);
      }
   }
}
```

47. Permutations II

Given a collection of numbers that might contain duplicates, return all possible unique permutations.

For example,
`[1,1,2]` have the following unique permutations:

```
[
  [1,1,2],
  [1,2,1],
  [2,1,1]
]
```

```
public List<List<Integer>> permuteUnique(int[] nums) {
    List<List<Integer>> list = new ArrayList<>();
    Arrays.sort(nums);
    backtrack(list, new ArrayList<>(), nums, new boolean[nums.length]);
    return list;
}

private void backtrack(List<List<Integer>> list, List<Integer> tempList, int [] nums, boolean [] used){
    if(tempList.size() == nums.length){
        list.add(new ArrayList<>(tempList));
    } else{
        for(int i = 0; i < nums.length; i++){
            if(used[i]) continue;
            if(i>0 &&nums[i-1]==nums[i] && !used[i-1]) continue;
            used[i] = true;
            tempList.add(nums[i]);
            backtrack(list, tempList, nums, used);
            used[i] = false;
            tempList.remove(tempList.size() - 1);
        }
    }
}
```

236	Lowest Common Ancestor of a Binary Tree	29.7%

```
public TreeNode lowestCommonAncestor(TreeNode root, TreeNode p, TreeNode q) {
        if( root == p || root == q || root == null)
            return root;
        TreeNode left = lowestCommonAncestor( root.left,  p,  q);
        TreeNode right = lowestCommonAncestor( root.right,  p,  q);
        if(left == null)
            return right;
        else if (right == null)
            return left;
        else
            return root;

    }
```

49	Group Anagrams	33.7%

```
public class Solution {
    public List<List<String>> groupAnagrams(String[] strs) {
        if (strs == null || strs.length == 0) return new ArrayList<List<Strin
g>>();
        Map<String, List<String>> map = new HashMap<String, List<String>>();
        for (String s : strs) {
            char[] ca = s.toCharArray();
            Arrays.sort(ca);
            String keyStr = String.valueOf(ca);
            if (!map.containsKey(keyStr)) map.put(keyStr, new ArrayList<Strin
g>());
            map.get(keyStr).add(s);
        }
        return new ArrayList<List<String>>(map.values());
    }
}
```

79	Word Search	26.3%

Given **board** =

```
[
  ['A','B','C','E'],
  ['S','F','C','S'],
  ['A','D','E','E']
]
```

word = `"ABCCED"`, -> returns `true`,
word = `"SEE"`, -> returns `true`,
word = `"ABCB"`, -> returns `false`.

Could not reuse an index of the board. So set up a marker to xor with char (toggling used or unused) to avoid extra space.

```
public boolean exist(char[][] board, String word) {
    char[] w = word.toCharArray();
    for (int y=0; y<board.length; y++) {
        for (int x=0; x<board[y].length; x++) {
                if (exist(board, y, x, w, 0)) return true;
        }
    }
    return false;
}

private boolean exist(char[][] board, int y, int x, char[] word, int i) {
        if (i == word.length) return true;
        if (y<0 || x<0 || y == board.length || x == board[y].length) return fa
lse;
        if (board[y][x] != word[i]) return false;
        board[y][x] ^= 256;
        boolean exist = exist(board, y, x+1, word, i+1)
                || exist(board, y, x-1, word, i+1)
                || exist(board, y+1, x, word, i+1)
                || exist(board, y-1, x, word, i+1);
        board[y][x] ^= 256;
        return exist;
}
```

238	Product of Array Except Self	48.6%

```
{       1,      a[0],   a[0]*a[1],   a[0]*a[1]*a[2], }
{ a[1]*a[2]*a[3],   a[2]*a[3],       a[3],           1, }
```

```
int a[N] // This is the input
int products[N];

// Get the products below the current index
p=1;
for(int i=0;i<N;++i) {
  products[i]=p;
  p*=a[i];
}

// Get the products above the curent index
p=1;
for(int i=N-1;i>=0;--i) {
  products[i]*=p;
  p*=a[i];
}
```

38	Count and Say	34.0%

```
1.  1
2.  11
3.  21
4.  1211
5.  111221
```

```
public String countAndSay(int n) {
         String s = "1";
        while (n-- > 1) { /* invariant: s is nth */
            StringBuilder next = new StringBuilder(); /* invariant: contain
cnt-say before cur */
            for (int i = 0, cnt = 1; i < s.length(); i++, cnt++) {
                if (i == s.length()-1 || s.charAt(i+1) != s.charAt(i)) {
                    next.append(cnt).append(s.charAt(i));
                    cnt = 0;
                }
            }
            s = next.toString();
        }
        return s;
    }
}
```

228. Summary Ranges

For example, given `[0,1,2,4,5,7]`, return `["0->2","4->5","7"].`

```
public List<String> summaryRanges(int[] nums) {
        List<String> ret = new ArrayList<>();
        int n = nums.length;
        for (int i = 1, j = 0; i <= n; i++) {
            if (i == n || nums[i - 1] != nums[i] - 1) {
                ret.add(j == i - 1 ? nums[j] + "" : nums[j] + "->" + nums[i -
 1]);
                j = i;
            }
        }
        return ret;
    }
```

```java
// Encode string from "aaabccccc" -> "3ab5c"
    public String encode(String word) {
        StringBuilder enc = new StringBuilder();
        int n = word.length();
        for (int i = 1, cnt = 1; i <= n; i++, cnt++) {
            if (i == n || word.charAt(i - 1) != word.charAt(i)) {
                if (cnt > 1) {
                    enc.append(cnt);
                }
                enc.append(word.charAt(i - 1));
                cnt = 0;
            }
        }
        return enc.length() < word.length() ? enc.toString() : word;
    }
```

215	Kth Largest Element in an Array	38.8%

```java
public int findKthLargest(int[] nums, int k) {
        k = nums.length - k;
        int lo = 0;
        int hi = nums.length - 1;
        while (lo < hi) {
            final int j = partition(nums, lo, hi);
            if(j < k) {
                lo = j + 1;
            } else if (j > k) {
                hi = j - 1;
            } else {
                break;
            }
        }
        return nums[k];
    }
    private int partition(int[] a, int lo, int hi) {

        int i = lo;
        int j = hi;
        while(i<j) {
            while(i < hi && (a[i]<= a[lo]))
                i++;
            while(j > lo && (a[lo] <= a[j]))
                j--;
            if(i < j) {
                swap(a, i, j);
            }

        }
        swap(a, lo, j);
        return j;
    }
    private void swap(int[] a, int i, int j) {
        final int tmp = a[i];
```

```
        a[i] = a[j];
        a[j] = tmp;
    }
```

209	Minimum Size Subarray Sum	30.1%

```
    public int minSubArrayLen(int s, int[] nums) {
        int p1=0;
        int p2 =0;
        int sum = 0;
        int minLen = Integer.MAX_VALUE;
        while(p2<nums.length){
            sum+=nums[p2++];
            while(sum>=s){
                minLen = Math.min(minLen,p2-p1);
                sum-=nums[p1++];

            }
        }
        return (minLen == Integer.MAX_VALUE) ? 0 : minLen;

    }
```

57	Insert Interval	27.2%

```
Change newInterval in place (change start/end or set it to null)

public List<Interval> insert(List<Interval> intervals, Interval newInterval)
{
        int start = newInterval.start;
        int end = newInterval.end;
        List<Interval> res = new ArrayList<Interval>();
        boolean addMerge = false;
        if(intervals.size()==0)
            res.add(newInterval);
        for(int j =0;j<intervals.size();j++){
            Interval i = intervals.get(j);
            if(newInterval==null||i.end<newInterval.start){
                res.add(i);
            }
            else if(i.start>newInterval.end){
                res.add(newInterval);
                res.add(i);
                newInterval=null;
            }
            else{
                newInterval.end = Math.max(i.end,newInterval.end);
                newInterval.start = Math.min(i.start,newInterval.start);
            }
        }
```

```
         if (newInterval != null)
            res.add(newInterval);
            return res;
    }


public List<Interval> insert(List<Interval> intervals, Interval newInterval)
{``
        int i=0;
        while(i<intervals.size() && intervals.get(i).end<newInterval.start) i
++;
        while(i<intervals.size() && intervals.get(i).start<=newInterval.end){
            newInterval = new Interval(Math.min(intervals.get(i).start, newIn
terval.start), Math.max(intervals.get(i).end, newInterval.end));
            intervals.remove(i);
        }
        intervals.add(i,newInterval);
        return intervals;
}
```

71	Simplify Path	24.9%

```
    public String simplifyPath(String path) {
            Deque<String> stack = new ArrayDeque<>();
            Set<String> skip = new HashSet<>(Arrays.asList("..",".",""));
            for (String dir : path.split("/")) {
                if (dir.equals("..") && !stack.isEmpty()) stack.pop();
                else if (!skip.contains(dir)) stack.push(dir);
            }
            String res = "";
            while(!stack.isEmpty()) res ="/"+stack.pop() + res ;
            return res.isEmpty() ? "/" : res;
        }

    Stack is deprecated. Use deque (ArrayDeque) as double-ended queue/stack.
```

```
dequeA.add     ("element 1"); //add element at tail
dequeA.addFirst("element 2"); //add element at head
dequeA.addLast ("element 3"); //add element at tail
Object firstElement = dequeA.remove();
Object firstElement = dequeA.removeFirst();
Object lastElement  = dequeA.removeLast();
Object firstElement = dequeA.element();
Object firstElement = dequeA.getFirst();
Object lastElement  = dequeA.getLast();
```

146	LRU Cache	17.3%

`get(key)` - Get the value (will always be positive) of the key if the key exists in the cache, otherwise return -1.

`put(key, value)` - Set or insert the value if the key is not already present. When the cache reached its capacity, it should invalidate the least recently used item before inserting a new item.

Keep a hash table that keeps track of the keys and its values in the double linked list.
It takes constant time to add and remove nodes from the head or tail.

```
class DLinkedNode {
        int key;
        int value;
        DLinkedNode pre;
        DLinkedNode post;
}

/**
 * Always add the new node right after head;
 */
private void addNode(DLinkedNode node){
        node.pre = head;
        node.post = head.post;

        head.post.pre = node;
        head.post = node;
}

/**
 * Remove an existing node from the linked list.
 */
private void removeNode(DLinkedNode node){
        DLinkedNode pre = node.pre;
        DLinkedNode post = node.post;

        pre.post = post;
        post.pre = pre;
}

/**
 * Move certain node in between to the head.
 */
private void moveToHead(DLinkedNode node){
        this.removeNode(node);
        this.addNode(node);
}

// pop the current tail.
private DLinkedNode popTail(){
        DLinkedNode res = tail.pre;
        this.removeNode(res);
        return res;
}

private Hashtable<Integer, DLinkedNode>
        cache = new Hashtable<Integer, DLinkedNode>();
private int count;
private int capacity;
private DLinkedNode head, tail;
```

```
public LRUCache(int capacity) {
        this.count = 0;
        this.capacity = capacity;

        head = new DLinkedNode();
        head.pre = null;

        tail = new DLinkedNode();
        tail.post = null;

        head.post = tail;
        tail.pre = head;
}

public int get(int key) {

        DLinkedNode node = cache.get(key);
        if(node == null){
                return -1; // should raise exception here.
        }

        // move the accessed node to the head;
        this.moveToHead(node);

        return node.value;
}


public void set(int key, int value) {
        DLinkedNode node = cache.get(key);

        if(node == null){

                DLinkedNode newNode = new DLinkedNode();
                newNode.key = key;
                newNode.value = value;

                this.cache.put(key, newNode);
                this.addNode(newNode);

                ++count;

                if(count > capacity){
                        // pop the tail
                        DLinkedNode tail = this.popTail();
                        this.cache.remove(tail.key);
                        --count;
                }
        }else{
                // update the value.
                node.value = value;
                this.moveToHead(node);
        }
```

```
}
```

13	Roman to Integer	45.2%

```
Input : "XIV"
Return : 14
Input : "XX"
Output : 20
```

If current num[i] is smaller than next num[i+1], num[i] should be subtracted. Otherwise, add num[i]. Finally add the last bit anyway.

IV = 5 – 1, VI = 5 + 1

```
public int romanToInt(String s) {
    int nums[]=new int[s.length()];
    for(int i=0;i<s.length();i++){
        switch (s.charAt(i)){
            case 'M':
                nums[i]=1000;
                break;
            case 'D':
                nums[i]=500;
                break;
            case 'C':
                nums[i]=100;
                break;
            case 'L':
                nums[i]=50;
                break;
            case 'X' :
                nums[i]=10;
                break;
            case 'V':
                nums[i]=5;
                break;
            case 'I':
                nums[i]=1;
                break;
        }
    }
    int sum=0;
    for(int i=0;i<nums.length-1;i++){
        if(nums[i]<nums[i+1])
            sum-=nums[i];
        else
            sum+=nums[i];
    }
    return sum+nums[nums.length-1];
}
```

33	Search in Rotated Sorted Array	32.1%

The idea is that when rotating the array, there must be one half of the array that is still in sorted order.
For example, 6 7 1 2 3 4 5, the order is disrupted from the point between 7 and 1. So when doing binary search, we can make a judgement that which part is ordered and whether the target is in that range, if yes, continue the search in that half, if not continue in the other half.

```
public class Solution {
    public int search(int[] nums, int target) {
        int start = 0;
        int end = nums.length - 1;
        while (start <= end){
            int mid = (start + end) / 2;
            if (nums[mid] == target)
                return mid;

            if (nums[start] <= nums[mid]){
                 if (target < nums[mid] && target >= nums[start])
                    end = mid - 1;
                 else
                    start = mid + 1;
            }

            if (nums[mid] <= nums[end]){
                if (target > nums[mid] && target <= nums[end])
                    start = mid + 1;
                 else
                    end = mid - 1;
            }
        }
        return -1;
    }
}
```

44	Wildcard Matching	19.8%

dp[i][j] denotes whether s[0....i-1] matches p[0.....j-1],

First, we need to initialize dp[i][0], i= [1,m]. All the dp[i][0] should be false because p has nothing in it.

Then, initialize dp[0][j], j = [1, n]. In this case, s has nothing, to get dp[0][j] = true, p must be '*', '*', '**',etc. Once p.charAt(j-1) != '*', all the dp[0][j] afterwards will be false.

```
public boolean isMatch_2d_method(String s, String p) {
        int m=s.length(), n=p.length();
        boolean[][] dp = new boolean[m+1][n+1];
        dp[0][0] = true;
        for (int i=1; i<=m; i++) {
                dp[i][0] = false;
        }

        for(int j=1; j<=n; j++) {
                if(p.charAt(j-1)=='*'){
                        dp[0][j] = true;
                } else {
                        break;
                }
        }

        for(int i=1; i<=m; i++) {
                for(int j=1; j<=n; j++) {
                        if (p.charAt(j-1)!='*') {
                                dp[i][j] = dp[i-1][j-1] && (s.charAt(i-1)==p.ch
arAt(j-1) || p.charAt(j-1)=='?');
                        } else {
                                dp[i][j] = dp[i-1][j] || dp[i][j-1];
                        }
                }
        }
        return dp[m][n];
}
```

For each element in s
If *s==*p or *p == ? which means this is a match, then goes to next element s++ p++.
If p=='*', this is also a match, but one or many chars may be available, so let us save this *'s position and the matched s position.
If not match, then we check if there is a * previously showed up,
    if there is no *, return false;
    if there is an *, we set current p to the next element of *, and set current s to the next saved s position.

e.g.

abed
?b*d**

a=?, go on, b=b, go on,
e=*, save * position star=3, save s position ss = 3, p++
e!=d, check if there was a *, yes, ss++, s=ss; p=star+1
d=d, go on, meet the end.
check the rest element in p, if all are *, true, else false;

```
boolean comparison(String str, String pattern) {
        int s = 0, p = 0, match = 0, starIdx = -1;
        while (s < str.length()){
            // advancing both pointers
            // match: s_last_match_begin
            // starIdx: p_last_asterisk_pos

            if (p < pattern.length()  && (pattern.charAt(p) == '?' || str.cha
rAt(s) == pattern.charAt(p))){
                s++;
                p++;
            }
            // * found, only advancing pattern pointer
            else if (p < pattern.length() && pattern.charAt(p) == '*'){
                starIdx = p;
                match = s;
                p++;
            }
           // last pattern pointer was *, advancing string pointer
            else if (starIdx != -1){
                p = starIdx + 1;
                match++;
                s = match;
            }
           //current pattern pointer is not star, last patter pointer was not
 *
          //characters do not match
            else return false;
        }

        //check for remaining characters in pattern
        while (p < pattern.length() && pattern.charAt(p) == '*')
            p++;

        return p == pattern.length();
```

}

380	Insert Delete GetRandom O(1)	39.0%

1. `insert(val)`: Inserts an item val to the set if not already present.
2. `remove(val)`: Removes an item val from the set if present.
3. `getRandom`: Returns a random element from current set of elements. Each element must have the **same probability** of being returned.

```
HashMap (int, set of int) to store the values and its locations (if dups). ArrayList s
tores values at specific locations.
Remove will remove the element and swap the last element to the empty location and upd
ate locations.
        ArrayList<Integer> nums;
            HashMap<Integer, Set<Integer>> locs;
            java.util.Random rand = new java.util.Random();
            /** Initialize your data structure here. */
            public RandomizedSet() {
                nums = new ArrayList<Integer>();
                locs = new HashMap<Integer, Set<Integer>>();
            }
/** Inserts a value to the set. Returns true if the set did not already conta
in the specified element. */
            public boolean insert(int val) {
                boolean contain = locs.containsKey(val);
                if ( ! contain ) locs.put( val, new HashSet<Integer>() );
                locs.get(val).add(nums.size());
                nums.add(val);
                return ! contain ;

 /** Removes a value from the set. Returns true if the set contained the spec
ified element. */
            public boolean remove(int val) {
                boolean contain = locs.containsKey(val);
                if ( ! contain ) return false;
                int loc = locs.get(val).iterator().next();
                        locs.get(val).remove(loc);
                if (loc < nums.size() - 1 ) {
                    int lastone = nums.get(nums.size() - 1 );
                    nums.set( loc , lastone );
                    locs.get(lastone).remove(nums.size() - 1);
                    locs.get(lastone).add(loc);
                }
                nums.remove(5.size() - 1);
                if (locs.get(val).isEmpty()) locs.remove(val);
                return true;
            }

            /** Get a random element from the set. */
            public int getRandom() {
                return nums.get( rand.nextInt(nums.size()) );
            }
```

128	Longest Consecutive Sequence	36.5%

476. Number Complement

```
        unsigned mask = ~0;
        while (num & mask) mask <<= 1;
        return ~mask & ~num;
```

258. Add Digits

```
public int addDigits(int num) {

        return num==0?0:(num%9==0?9:(num%9));

    }
```