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* [2.131. 移动窗口求每个窗口元素最大值](#2131-移动窗口求每个窗口元素最大值)
* [2.132. 数字转换为英文单词组合](#2132-数字转换为英文单词组合)
* [2.133. 二叉树的序列化和反序列化](#2133-二叉树的序列化和反序列化)
* [2.134. 移除字符串中的重复字符，并使得最终结果字典序最小](#2134-移除字符串中的重复字符并使得最终结果字典序最小)
* [2.135. 信封俄罗斯套娃](#2135-信封俄罗斯套娃)
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* [2.139. 滑动窗口中间值](#2139-滑动窗口中间值)
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* [2.142. 数组中寻找三个长为k的不重叠子数组，使得其和最大](#2142-数组中寻找三个长为k的不重叠子数组使得其和最大)
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* [2.146. 最小公倍数](#2146-最小公倍数)

## 1. 数据结构

### 1.1. 单例模式

public class Singleton {
 private volatile static Singleton instance;

 private Singleton() {}

 public static Singleton getInstance() {
 if (instance == null) {
 synchronized (Singleton.class) {
 if (instance == null) {
 instance = new Singleton();
 }
 }
 }
 return instance;
 }
}

### 1.2. 排序

#### 1.2.1. 快速排序partition过程

##### 2.1.1. 方法一

def partition(array, low, high):
 pivot = array[low]
 while low < high:
 while low < high and array[high] >= pivot:
 high -= 1
 array[low] = array[high]
 while low < high and array[low] <= pivot:
 low += 1
 array[high] = array[low]
 array[low] = pivot
 return low

##### 2.1.2. 方法二

def partition2(array, low, high):
 def swap(array, i, j):
 array[i], array[j] = array[j], array[i]

 pivot = array[high]
 current = low
 for i in range(low, high):
 if array[i] < pivot:
 swap(array, i, current)
 current += 1
 swap(array, high, current)
 return current

##### 2.1.3. 方法三

def partition3(array, low, high):
 def swap(array, i, j):
 array[i], array[j] = array[j], array[i]

 start = low
 pivot = array[low]
 low += 1
 while low <= high:
 while low <= high and array[low] <= pivot:
 low += 1
 while low <= high and array[high] >= pivot:
 high -= 1
 if low < high:
 swap(array, low, high)
 swap(array, start, high)
 return high

#### 1.2.2. 快速排序

##### 2.2.1. 递归

def quick\_sort(array, low, high):
 if low >= high:
 return
 mid = partition(array, low, high)
 quick\_sort(array, low, mid - 1)
 quick\_sort(array, mid + 1, high)

#### 1.2.3. 非递归

def quick\_sort(array, low, high):
 stack = []
 stack.append(low)
 stack.append(high)
 while stack:
 high = stack.pop()
 low = stack.pop()
 if low >= high:
 continue
 mid = partition(array, low, high)
 stack.append(low)
 stack.append(mid - 1)
 stack.append(mid + 1)
 stack.append(high)

#### 1.2.4. 插入排序

def insertion\_sort(array):
 for i in range(1, len(array)):
 temp = array[i]
 j = i - 1
 while j >= 0 and temp < array[j]:
 array[j + 1] = array[j]
 j -= 1
 array[j + 1] = temp

#### 1.2.5. 冒泡排序

def bubble\_sort(array):
 def swap(array, i, j):
 array[i], array[j] = array[j], array[i]

 for j in range(len(array) - 1, 0, -1):
 flag = True
 for i in range(0, j):
 if array[i] > array[i + 1]:
 swap(array, i, i + 1)
 flag = False
 if flag:
 break

#### 1.2.6. 选择排序

def selection\_sort(array):
 def swap(array, i, j):
 array[i], array[j] = array[j], array[i]

 for i in range(0, len(array) - 1):
 min\_index = i
 for j in range(i + 1, len(array)):
 if array[j] < array[min\_index]:
 min\_index = j
 swap(array, i, min\_index)

#### 1.2.7. 归并排序

##### 2.6.1. 递归

def merge(array, temp\_array, low, mid, high):
 start1 = low
 end1 = mid
 start2 = mid + 1
 end2 = high
 k = low
 while start1 <= end1 and start2 <= end2:
 if array[start1] < array[start2]:
 temp\_array[k] = array[start1]
 start1 += 1
 else:
 temp\_array[k] = array[start2]
 start2 += 1
 k += 1
 while start1 <= end1:
 temp\_array[k] = array[start1]
 start1 += 1
 k += 1
 while start2 <= end2:
 temp\_array[k] = array[start2]
 start2 += 1
 k += 1
 for k in range(low, high + 1):
 array[k] = temp\_array[k]

def merge\_sort\_real(array, temp\_array, low, high):
 if low >= high:
 return
 mid = (low + high) // 2
 merge\_sort\_real(array, temp\_array, low, mid)
 merge\_sort\_real(array, temp\_array, mid + 1, high)
 merge(array, temp\_array, low, mid, high)

def merge\_sort(array):
 merge\_sort\_real(array, [0] \* len(array), 0, len(array) - 1)

##### 2.6.2. 非递归

def merge\_sort(array):
 length = len(array)
 temp\_array = [0] \* length
 block = 1
 while block < length \* 2:
 for start in range(0, length, 2 \* block):
 low = start
 mid = (start + block) if (start + block) < length else length
 high = (start + 2 \* block) if (start + 2 \* block) < length else length
 start1 = low
 end1 = mid
 start2 = mid
 end2 = high
 k = low
 while start1 < end1 and start2 < end2:
 if array[start1] < array[start2]:
 temp\_array[k] = array[start1]
 start1 += 1
 else:
 temp\_array[k] = array[start2]
 start2 += 1
 k += 1
 while start1 < end1:
 temp\_array[k] = array[start1]
 start1 += 1
 k += 1
 while start2 < end2:
 temp\_array[k] = array[start2]
 start2 += 1
 k += 1
 array, temp\_array = temp\_array, array
 block \*= 2

#### 1.2.8. 堆排序

def heap\_sort(array):
 def swap(array, i, j):
 array[i], array[j] = array[j], array[i]

 def shift\_down(start, end):
 root = start
 while True:
 child = 2 \* root + 1
 if child > end:
 break
 if child + 1 <= end and array[child] < array[child + 1]:
 child += 1
 if array[root] < array[child]:
 swap(array, root, child)
 root = child
 else:
 break

 def build\_heap(array):
 length = len(array)
 for start in range((length - 1) // 2, -1, -1):
 shift\_down(start, length - 1)

 build\_heap(array)
 for end in range(len(array) - 1, 0, -1):
 swap(array, 0, end)
 shift\_down(0, end - 1)

### 1.3. 链表

#### 1.3.1. 反转链表（头插法）

def reverse\_list(head):
 if not head:
 return head
 new\_head = head
 while head.next:
 current = head.next
 head.next = head.next.next
 current.next = new\_head
 new\_head = current
 return new\_head

#### 1.3.2. 单链表去重

public ListNode deleteDuplicates(ListNode head) {
 ListNode p = head;
 while (p != null) {
 if (p.next != null && p.next.val == p.val) {
 p.next = p.next.next;
 } else {
 p = p.next;
 }
 }
 return head;
}

#### 1.3.3. 合并两个链表

##### 3.3.1. 不创建临时结点

public ListNode mergeTwoLists(ListNode l1, ListNode l2) {
 if (l1 == null) {
 return l2;
 }
 if (l2 == null) {
 return l1;
 }
 if (l1.val > l2.val) {
 ListNode temp = l1;
 l1 = l2;
 l2 = temp;
 }
 ListNode p = l1;
 while (p != null) {
 while (l2 != null && (p.next == null || l2.val < p.next.val)) {
 ListNode temp = l2;
 l2 = l2.next;
 temp.next = p.next;
 p.next = temp;
 p = p.next;
 }
 p = p.next;
 }
 return l1;
}

##### 3.3.2. 创建临时结点

public ListNode mergeTwoLists(ListNode l1, ListNode l2) {
 ListNode fakeHead = new ListNode(0);
 ListNode tail = fakeHead;
 while (l1 != null && l2 != null) {
 if (l1.val < l2.val) {
 tail.next = l1;
 l1 = l1.next;
 } else {
 tail.next = l2;
 l2 = l2.next;
 }
 tail = tail.next;
 }
 tail.next = l1 == null ? l2 : l1;
 return fakeHead.next;
}

#### 1.3.4. 链表排序

def sortList(self, head):
 """
 :type head: ListNode
 :rtype: ListNode
 """
 if not head or not head.next:
 return head
 slow = head
 fast = head
 prev = None
 while fast and fast.next:
 prev = slow
 slow = slow.next
 fast = fast.next.next
 prev.next = None
 a = sortList(head)
 b = sortList(slow)
 fake\_head = ListNode(0)
 temp = fake\_head
 while a and b:
 if a.val < b.val:
 temp.next = a
 a = a.next
 else:
 temp.next = b
 b = b.next
 temp = temp.next
 if a:
 temp.next = a
 else:
 temp.next = b
 return fake\_head.next

#### 1.3.5. 检查回文链表

def isPalindrome(head):
 """
 :type head: ListNode
 :rtype: bool
 """
 if not head or not head.next:
 return True
 slow = head
 fast = head
 while fast and fast.next:
 slow = slow.next
 fast = fast.next.next
 temp = None
 while slow:
 next = slow.next
 slow.next = temp
 temp = slow
 slow = next
 slow = temp
 while head and slow:
 if head.val != slow.val:
 return False
 head = head.next
 slow = slow.next
 return True

#### 1.3.6. 链表等概率随机抽取元素

public int getRandom(ListNode head) {
 ListNode node = head;
 int result = -1;
 int count = 1;
 Random random = new Random();
 while (node != null) {
 if (random.nextInt(count) == 0) {
 result = node.val;
 }
 count++;
 node = node.next;
 }
 return result;
}

#### 1.3.7. 链表按奇数序号和偶数序号重排

def oddEvenList(head):
 """
 :type head: ListNode
 :rtype: ListNode
 """
 if not head:
 return None
 odd = head
 even = head.next
 even\_head = even
 while even and even.next:
 odd.next = odd.next.next
 even.next = even.next.next
 odd = odd.next
 even = even.next
 odd.next = even\_head
 return head

### 1.4. 二叉树遍历

#### 1.4.1. 二叉树前序遍历

##### 4.1.1. 递归

def pre\_order(root):
 if root:
 print(root.val)
 pre\_order(root.left)
 pre\_order(root.right)

##### 4.1.2. 非递归

def pre\_order(root):
 stack = []
 while root or stack:
 if root:
 print(root.val)
 stack.append(root)
 root = root.left
 else:
 node = stack.pop()
 root = node.right

#### 1.4.2. 二叉树中序遍历

##### 4.2.1. 递归

def in\_order(root):
 if root:
 in\_order(root.left)
 print(root.val)
 in\_order(root.right)

##### 4.2.2. 非递归

def in\_order(root):
 stack = []
 while root or stack:
 if root:
 stack.append(root)
 root = root.left
 else:
 node = stack.pop()
 print(node.val)
 root = node.right

#### 1.4.3. 二叉树后序遍历

##### 4.3.1. 递归

def post\_order(root):
 if root:
 post\_order(root.left)
 post\_order(root.right)
 print(root.val)

##### 4.3.2. 非递归

def post\_order(root):
 stack = []
 result = []
 node = root
 while node or stack:
 if node:
 stack.append(node)
 result.append(node.val)
 node = node.right
 else:
 node = stack.pop()
 node = node.left
 result.reverse()
 return result

#### 1.4.4. 二叉树层次遍历

def level\_order(root):
 if not root:
 return
 queue = collections.deque()
 queue.append(root)
 while queue:
 size = len(queue)
 for i in range(size):
 node = queue.popleft()
 print(node.val)
 if node.left:
 queue.append(node.left)
 if node.right:
 queue.append(node.right)

### 1.5. 图

#### 1.5.1. Dijkstra算法

##### 5.1.1. 朴素

def dijkstra(start, end, graph, n):
 """
 :param start: int, [1,n]
 :param end: int, [1,n]
 :param graph: dict, {from: (to, distance), from: (to, distance)...}
 :param n: int
 :return: (int, list), minimum distance, path
 """
 d = [sys.maxsize] \* (n + 1)
 previous = [None] \* (n + 1)
 d[start] = 0
 candidates = set(i for i in range(1, n + 1))
 while candidates:
 min\_d = sys.maxsize
 u = -1
 for candidate in candidates:
 if min\_d > d[candidate]:
 min\_d = d[candidate]
 u = candidate
 if u == end:
 return d[u], previous
 candidates.remove(u)
 for v, dist in graph[u]:
 if d[v] > d[u] + dist:
 d[v] = d[u] + dist
 previous[v] = u

##### 5.1.2. 堆优化

def dijkstra(start, end, graph, n):
 """
 :param start: int, [1,n]
 :param end: int, [1,n]
 :param graph: dict, {from: (to, distance), from: (to, distance)...}
 :param n: int
 :return: (int, list), minimum distance, path
 """
 d = [sys.maxsize] \* (n + 1)
 previous = [None] \* (n + 1)
 d[start] = 0
 candidates = set(i for i in range(1, n + 1))
 heap = []
 heapq.heappush(heap, (0, start))
 while candidates:
 distance, u = heapq.heappop()
 if u == end:
 return d[u], previous
 if u not in candidates:
 continue
 candidates.remove(u)
 for v, dist in graph[u]:
 if d[v] > d[u] + dist:
 d[v] = d[u] + dist
 heapq.heappush(heap, (d[v], v))
 previous[v] = u

#### 1.5.2. Floyd-Warshall算法

def floyd\_warshall(graph, n):
 INF = 10000
 dist = [[INF] \* n for \_ in range(n)]
 path = [[-1] \* n for \_ in range(n)]
 for i in range(n):
 for j in range(n):
 if i == j:
 dist[i][j] = 0
 elif graph[i][j] < INF:
 dist[i][j] = graph[i][j]
 for k in range(n):
 for i in range(n):
 for j in range(n):
 if dist[i][j] > dist[i][k] + dist[k][j]:
 dist[i][j] = dist[i][k] + dist[k][j]
 path[i][j] = k
 return dist, path

#### 1.5.3. 拓扑排序

##### 5.3.1. DFS

def topological\_sort(graph, n):
 order = []
 visiting = [False] \* n
 visited = [False] \* n
 for i in range(n):
 if not visited[i]:
 if not dfs(graph, i, visiting, visited, order):
 raise ValueError('cycle')
 order.reverse()
 return order

def dfs(graph, index, visiting, visited, order):
 visiting[index] = True
 visited[index] = True
 for neighbor in graph[index]:
 if visiting[neighbor]:
 return False
 if not visited[neighbor]:
 if not dfs(graph, neighbor, visiting, visited, order):
 return False
 order.append(index)
 visiting[index] = False
 return True

##### 5.3.2. BFS

def topological\_sort(graph, n):
 in\_degrees = [0] \* n
 for i in range(n):
 for index in graph[i]:
 in\_degrees[index] += 1
 candidates = set()
 for i in range(n):
 if in\_degrees[i] == 0:
 candidates.add(i)
 order = []
 while candidates:
 index = candidates.pop()
 order.append(index)
 for neighbor in graph[index]:
 in\_degrees[neighbor] -= 1
 if in\_degrees[neighbor] == 0:
 candidates.add(neighbor)
 if len(order) != n:
 raise ValueError('cycle')
 return order

### 1.6. 查找

#### 1.6.1. 二分搜索

def binary\_search(array, key):
 low = 0
 high = len(array) - 1
 while low <= high:
 mid = (low + high) // 2
 if array[mid] == key:
 return mid
 elif array[mid] > key:
 high = mid - 1
 else:
 low = mid + 1
 return -1

#### 1.6.2. 并查集

class UnionFind:
 def \_\_init\_\_(self, n):
 self.count = n
 self.parent = [i for i in range(n)]
 self.rank = [0] \* n

 def find(self, num):
 if num != self.parent[num]:
 self.parent[num] = self.find(self.parent[num])
 return self.parent[num]

 def union(self, a, b):
 parent\_a = self.find(a)
 parent\_b = self.find(b)
 if parent\_a == parent\_b:
 return
 if self.rank[parent\_a] > self.rank[parent\_b]:
 self.parent[parent\_b] = parent\_a
 else:
 self.parent[parent\_a] = parent\_b
 if self.rank[parent\_a] == self.rank[parent\_b]:
 self.rank[parent\_b] += 1
 self.count -= 1

#### 1.6.3. Trie树

public class Trie {
 TrieNode root;

 class TrieNode {
 boolean isWord = false;
 char val;
 TrieNode[] children = new TrieNode[26];
 }

 public Trie() {
 root = new TrieNode();
 }

 public void insert(String word) {
 TrieNode current = root;
 for (char letter : word.toCharArray()) {
 if (current.children[letter - 'a'] == null) {
 current.children[letter - 'a'] = new TrieNode();
 current.children[letter - 'a'].val = letter;
 }
 current = current.children[letter - 'a'];
 }
 current.isWord = true;
 }

 public boolean search(String word) {
 TrieNode current = root;
 for (char letter : word.toCharArray()) {
 if (current.children[letter - 'a'] == null) {
 return false;
 }
 current = current.children[letter - 'a'];
 }
 return current.isWord;
 }

 public boolean startsWith(String prefix) {
 TrieNode current = root;
 for (char letter : prefix.toCharArray()) {
 if (current.children[letter - 'a'] == null) {
 return false;
 }
 current = current.children[letter - 'a'];
 }
 return true;
 }
}

### 1.7. 回溯

#### 1.7.1. N皇后问题

def n\_queens(n):
 """
 :type n: int
 :rtype: List[List[str]]
 """
 board = [['.'] \* n for \_ in range(n)]
 result = []
 back\_trace(board, 0, result)
 return result

def back\_trace(board, row\_index, result):
 if row\_index == len(board):
 result.append(convert(board))
 return
 for j in range(len(board[row\_index])):
 if is\_valid(board, row\_index, j):
 board[row\_index][j] = 'Q'
 back\_trace(board, row\_index + 1, result)
 board[row\_index][j] = '.'

def convert(board):
 return [''.join(row) for row in board]

def is\_valid(board, i, j):
 for x in range(i):
 for y in range(len(board[i])):
 if board[x][y] == 'Q' and (y == j or i - x == j - y or i - x == y - j):
 return False
 return True

### 1.8. 栈与队列

#### 1.8.1. 栈模拟队列

public class MyQueue {
 Stack<Integer> stackA;
 Stack<Integer> stackB;

 public MyQueue() {
 stackA = new Stack<>();
 stackB = new Stack<>();
 }

 public void push(int x) {
 stackA.add(x);
 }

 public int pop() {
 if (stackB.empty()) {
 while (!stackA.empty()) {
 stackB.add(stackA.pop());
 }
 }
 return stackB.pop();
 }

 public int peek() {
 if (stackB.empty()) {
 while (!stackA.empty()) {
 stackB.add(stackA.pop());
 }
 }
 return stackB.peek();
 }

 public boolean empty() {
 return stackA.empty() && stackB.empty();
 }
}

#### 1.8.2. 队列模拟栈

public class MyStack {
 Queue<Integer> queue;

 public MyStack() {
 queue = new LinkedList<>();
 }

 public void push(int x) {
 queue.add(x);
 for (int i = 0; i < queue.size() - 1; i++) {
 queue.add(queue.poll());
 }
 }

 public int pop() {
 return queue.poll();
 }

 public int top() {
 return queue.peek();
 }

 public boolean empty() {
 return queue.isEmpty();
 }
}

### 1.9. 同步问题

#### 1.9.1. 生产者——消费者模型

public class Main {
 public static void main(String[] args) {
 Queue<Integer> queue = new LinkedList<>();
 int maxSize = 10;
 Thread producer1 = new Producer(queue, maxSize, "Producer 1");
 Thread producer2 = new Producer(queue, maxSize, "Producer 2");
 Thread consumer1 = new Consumer(queue, "Consumer 1");
 Thread consumer2 = new Consumer(queue, "Consumer 2");

 producer1.start();
 consumer1.start();
 producer2.start();
 consumer2.start();
 }

 static class Producer extends Thread {
 Queue<Integer> queue;
 int maxSize;
 Random random;

 public Producer(Queue<Integer> queue, int maxSize, String name) {
 super(name);
 this.queue = queue;
 this.maxSize = maxSize;
 random = new Random();
 }

 @Override
 public void run() {
 while (true) {
 try {
 produce();
 } catch (InterruptedException e) {
 e.printStackTrace();
 }
 }
 }

 void produce() throws InterruptedException {
 synchronized (queue) {
 while (queue.size() == maxSize) {
 System.out.println("Queue is full, " + this.getName() + " is waiting");
 queue.wait();
 }
 int item = random.nextInt();
 queue.add(item);
 System.out.println(this.getName() + " produced " + item + ", queue size is " + queue.size() + " now");
 queue.notifyAll();
 Thread.sleep(new Random().nextInt(1000));
 }
 }
 }

 static class Consumer extends Thread {
 Queue<Integer> queue;
 Random random;

 public Consumer(Queue<Integer> queue, String name) {
 super(name);
 this.queue = queue;
 random = new Random();
 }

 @Override
 public void run() {
 while (true) {
 try {
 consume();
 } catch (InterruptedException e) {
 e.printStackTrace();
 }
 }
 }

 void consume() throws InterruptedException {
 synchronized (queue) {
 while (queue.isEmpty()) {
 System.out.println("Queue is empty, " + this.getName() + " is waiting");
 queue.wait();
 }
 int item = queue.remove();
 System.out.println(this.getName() + " consumed " + item + ", queue size is " + queue.size() + " now");
 queue.notifyAll();
 Thread.sleep(new Random().nextInt(1000));
 }
 }
 }
}

### 1.10. 缓存策略

#### 1.10.1. LRU

class LRUCache:
 class Node:
 def \_\_init\_\_(self, key, value):
 self.key = key
 self.val = value
 self.prev = None
 self.next = None

 def \_\_init\_\_(self, capacity):
 """
 :type capacity: int
 """
 self.capacity = capacity
 self.memory = {}
 self.head = self.Node(-1, -1)
 self.tail = self.Node(-1, -1)
 self.head.next = self.tail
 self.tail.prev = self.head

 def get(self, key):
 """
 :type key: int
 :rtype: int
 """
 if key not in self.memory:
 return -1
 node = self.memory[key]
 self.to\_head(node)
 return node.val

 def put(self, key, value):
 """
 :type key: int
 :type value: int
 :rtype: void
 """
 if key in self.memory:
 node = self.memory[key]
 node.val = value
 self.to\_head(node)
 else:
 if len(self.memory) == self.capacity:
 del self.memory[self.tail.prev.key]
 self.remove(self.tail.prev)
 node = self.Node(key, value)
 self.memory[key] = node
 self.add(node)

 def to\_head(self, node):
 self.remove(node)
 self.add(node)

 def remove(self, node):
 node.prev.next = node.next
 node.next.prev = node.prev

 def add(self, node):
 node.next = self.head.next
 self.head.next = node
 node.prev = self.head
 node.next.prev = node

#### 1.10.2. LFU

class LFUCache:
 class Node:
 def \_\_init\_\_(self, key, value, times):
 self.key = key
 self.value = value
 self.times = times
 self.prev = None
 self.next = None

 def \_\_init\_\_(self, capacity):
 """
 :type capacity: int
 """
 self.init\_capacity = capacity
 self.capacity = capacity
 self.memory\_nodes = {}
 self.memory\_times = {}
 self.head = self.Node(-1, -1, -1)
 self.tail = self.Node(-1, -1, -1)
 self.head.next = self.tail
 self.tail.prev = self.head

 def get(self, key):
 """
 :type key: int
 :rtype: int
 """
 if key not in self.memory\_nodes:
 return -1
 self.put(key, self.memory\_nodes[key].value)
 return self.memory\_nodes[key].value

 def put(self, key, value):
 """
 :type key: int
 :type value: int
 :rtype: void
 """
 if self.init\_capacity == 0:
 return
 if key in self.memory\_nodes:
 node = self.memory\_nodes[key]
 node.value = value

 if node.times + 1 in self.memory\_times:
 if self.memory\_times[node.times] == node:
 if node.next.times == node.times:
 self.memory\_times[node.times] = node.next
 else:
 del self.memory\_times[node.times]
 node.prev.next = node.next
 node.next.prev = node.prev
 node.prev = self.memory\_times[node.times + 1].prev
 node.next = self.memory\_times[node.times + 1]
 node.next.prev = node
 node.prev.next = node
 self.memory\_times[node.times + 1] = node
 else:
 if self.memory\_times[node.times] != node:
 node.prev.next = node.next
 node.next.prev = node.prev
 node.prev = self.memory\_times[node.times].prev
 node.next = self.memory\_times[node.times]
 node.next.prev = node
 node.prev.next = node
 else:
 if node.next.times == node.times:
 self.memory\_times[node.times] = node.next
 else:
 del self.memory\_times[node.times]
 self.memory\_times[node.times + 1] = node
 node.times += 1
 else:
 node = self.Node(key, value, 1)
 self.memory\_nodes[key] = node
 if self.capacity == 0:
 node\_to\_remove = self.tail.prev
 if self.memory\_times[node\_to\_remove.times] == node\_to\_remove:
 del self.memory\_times[node\_to\_remove.times]
 node\_to\_remove.prev.next = node\_to\_remove.next
 node\_to\_remove.next.prev = node\_to\_remove.prev
 del self.memory\_nodes[node\_to\_remove.key]
 self.capacity += 1
 if 1 in self.memory\_times:
 node.prev = self.memory\_times[1].prev
 node.next = self.memory\_times[1]

 else:
 node.prev = self.tail.prev
 node.next = self.tail
 node.next.prev = node
 node.prev.next = node
 self.memory\_times[1] = node
 self.capacity -= 1

### 1.11. 斐波拉契数列

#### 1.11.1. 自顶向下

def fibonacci(n):
 if n == 1 or n == 2:
 return 1
 return fibonacci(n - 1) + fibonacci(n - 2)

#### 1.11.2. 自底向上

def fibonacci(n):
 a = 1
 b = 1
 n -= 2
 while n > 0:
 temp = a + b
 a = b
 b = temp
 n -= 1
 return b

### 1.12. 动态规划

#### 1.12.1. 背包问题

##### 01背包

###### 求最大价值

def knapsack(max\_weight, weights, values):
 n = len(weights)
 dp = [[0] \* (max\_weight + 1) for \_ in range(n + 1)]
 for i in range(1, n + 1):
 for j in range(1, max\_weight + 1):
 dp[i][j] = dp[i - 1][j]
 if weights[i - 1] <= j:
 dp[i][j] = max(dp[i][j], dp[i - 1][j - weights[i - 1]] + values[i - 1])
 return dp[n][max\_weight]

def knapsack(max\_weight, weights, values):
 n = len(weights)
 dp = [0] \* (max\_weight + 1)
 for i in range(1, n + 1):
 for j in range(max\_weight, 0, -1):
 if weights[i - 1] <= j:
 dp[j] = max(dp[j], dp[j - weights[i - 1]] + values[i - 1])
 return dp[max\_weight]

if \_\_name\_\_ == '\_\_main\_\_':
 weights = [10, 20, 30]
 values = [60, 100, 120]
 max\_weight = 50
 print(knapsack(max\_weight, weights, values))

###### 输出价值最大时的方案

def knapsack(max\_weight, weights, values):
 n = len(weights)
 dp = [[0] \* (max\_weight + 1) for \_ in range(n + 1)]
 for i in range(1, n + 1):
 for j in range(1, max\_weight + 1):
 dp[i][j] = dp[i - 1][j]
 if weights[i - 1] <= j:
 dp[i][j] = max(dp[i][j], dp[i - 1][j - weights[i - 1]] + values[i - 1])
 j = max\_weight
 result = []
 for i in range(n, 0, -1):
 if dp[i][j] > dp[i - 1][j]:
 result.append(i - 1)
 j -= weights[i - 1]
 result.reverse()
 return result

if \_\_name\_\_ == '\_\_main\_\_':
 weights = [2, 2, 6, 5, 4]
 values = [6, 3, 5, 4, 6]
 max\_weight = 10
 print(knapsack(max\_weight, weights, values))

## 2. 经典题目

### 2.1. 计算数字二进制表示的1的个数

[Leetcode 461. Hamming Distance](https://leetcode.com/problems/hamming-distance/#/description)

def count\_1s(num):
 count = 0
 while num:
 num &= (num - 1)
 count += 1
 return count

### 2.2. 数组中除一个数仅出现一次外，其他数均出现两次，找出这个数

[Leetcode 136. Single Number](https://leetcode.com/problems/single-number/#/description)

def single\_number(nums):
 result = 0
 for num in nums:
 result ^= num
 return result

### 2.3. 长为n的数组中所有元素在[1, n]之间，元素最多出现两次，找出[1, n]中没出现的元素

[Leetcode 448. Find All Numbers Disappeared in an Array](https://leetcode.com/problems/find-all-numbers-disappeared-in-an-array/#/description)

def find\_disappeared\_numbers(nums):
 """
 :type nums: List[int]
 :rtype: List[int]
 """
 for num in nums:
 index = num if num > 0 else -num
 index -= 1
 if nums[index] > 0:
 nums[index] = -nums[index]
 result = []
 for (index, num) in enumerate(nums):
 if num > 0:
 result.append(index + 1)
 return result

### 2.4. 不用+和-计算两个数的和

[Leetcode 371. Sum of Two Integers](https://leetcode.com/problems/sum-of-two-integers/#/description)

public int getSum(int a, int b) {
 int sum = a ^ b;
 int part = a & b;
 while (part != 0) {
 int theA = sum;
 int theB = part << 1;
 sum = theA ^ theB;
 part = theA & theB;
 }
 return sum;
}

### 2.5. 反转二叉树

[Leetcode 226. Invert Binary Tree](https://leetcode.com/problems/invert-binary-tree/#/description)

def invertTree(root):
 """
 :type root: TreeNode
 :rtype: TreeNode
 """
 if root is None:
 return
 self.invertTree(root.left)
 self.invertTree(root.right)
 temp = root.left
 root.left = root.right
 root.right = temp
 return root

### 2.6. 把数组中所有0移动到尾部，数组元素保持相对顺序不变

[Leetcode 283. Move Zeroes](https://leetcode.com/problems/move-zeroes/#/description)

void moveZeroes(int[] nums) {
 int currentIndex = 0;
 for (int num : nums) {
 if (num != 0) nums[currentIndex] = num;
 currentIndex++;
 }
 while (currentIndex < nums.length) {
 nums[currentIndex] = 0;
 currentIndex++;
 }
}

### 2.7. 定义一次move是将长为n的数组中n-1个数均加1，最少多少个move可以使得数组中所有元素相等

[Leetcode 453. Minimum Moves to Equal Array Elements](https://leetcode.com/problems/minimum-moves-to-equal-array-elements/#/description)

def minMoves(nums):
 """
 :type nums: List[int]
 :rtype: int
 """
 return sum(nums) - min(nums) \* len(nums)

### 2.8. 找出长为n的数组中出现次数大于⌊ n/2 ⌋的元素

[Leetcode 169. Majority Element](https://leetcode.com/problems/majority-element/#/description)

def majorityElement(nums):
 """
 :type nums: List[int]
 :rtype: int
 """
 majority = None
 count = 0
 for num in nums:
 if count == 0:
 majority = num
 if majority == num:
 count += 1
 else:
 count -= 1
 return majority

### 2.9. 找出长为n的数组中出现次数大于⌊ n/k ⌋的元素

[Leetcode 229. Majority Element II](https://leetcode.com/problems/majority-element-ii/description/)

def majority\_element(nums, k):
 counters = {}
 for num in nums:
 if num in counters:
 counters[num] += 1
 elif len(counters.keys()) < k - 1:
 counters[num] = 1
 else:
 for key, count in counters.items():
 if count == 1:
 del counters[key]
 else:
 counters[key] -= 1
 for num in counters.keys():
 counters[num] = 0
 for num in nums:
 if num in counters:
 counters[num] += 1
 target = len(nums) // k
 result = []
 for num, count in counters.items():
 if count > target:
 result.append(num)
 return result

### 2.10. 十进制转换为7进制

[Leetcode 504. Base 7](https://leetcode.com/problems/base-7/#/description)

public String convertToBase7(int num) {
 if (num == 0) {
 return "0";
 }
 int sign = num >= 0 ? 1 : -1;
 num = Math.abs(num);
 StringBuilder builder = new StringBuilder();
 while (num != 0) {
 builder.append(num % 7);
 num /= 7;
 }
 if (sign < 0) {
 builder.append('-');
 }
 return builder.reverse().toString();
}

### 2.11. 指定长度二进制数，指定1的个数的所有可能情况

[Leetcode 401. Binary Watch](https://leetcode.com/problems/binary-watch/#/description)

def get\_combination(length, num\_ones):
 def combination(length, num\_ones, base, result):
 if num\_ones == 0:
 result.append(base)
 return
 if length == 0 or length < num\_ones:
 return
 combination(length - 1, num\_ones - 1, base + (1 << (length - 1)), result)
 combination(length - 1, num\_ones, base, result)

 result = []
 combination(length, num\_ones, 0, result)
 return result

### 2.12. 有序数组转二叉搜索树

[Leetcode 108. Convert Sorted Array to Binary Search Tree](https://leetcode.com/problems/convert-sorted-array-to-binary-search-tree/#/description)

TreeNode toBST(int[] nums, int start, int end) {
 if (start > end) {
 return null;
 }
 int mid = (start + end) / 2;
 TreeNode node = new TreeNode(nums[mid]);
 node.left = toBST(nums, start, mid - 1);
 node.right = toBST(nums, mid + 1, end);
 return node;
}

public TreeNode sortedArrayToBST(int[] nums) {
 if (nums.length == 0) {
 return null;
 }
 return toBST(nums, 0, nums.length - 1);
}

### 2.13. 最大连续子序列和

[Leetcode 121. Best Time to Buy and Sell Stock](https://leetcode.com/problems/best-time-to-buy-and-sell-stock/#/description)

#### 2.13.1. 最小值为0

def max\_subarray(nums):
 max\_ending\_here = 0
 max\_so\_far = 0
 for x in nums:
 max\_ending\_here = max(0, max\_ending\_here + x)
 max\_so\_far = max(max\_so\_far, max\_ending\_here)
 return max\_so\_far

#### 2.13.2. 最小值为负数

def max\_subarray(nums):
 max\_ending\_here = nums[0]
 max\_so\_far = nums[0]
 for x in nums[1:]:
 max\_ending\_here = max(x, max\_ending\_here + x)
 max\_so\_far = max(max\_so\_far, max\_ending\_here)
 return max\_so\_far

### 2.14. 最大连续子序列积

[Leetcode 152. Maximum Product Subarray](https://leetcode.com/problems/maximum-product-subarray/description/)

def maxProduct(self, nums):
 """
 :type nums: List[int]
 :rtype: int
 """
 if not nums:
 return 0
 max\_here = nums[0]
 min\_here = nums[0]
 max\_so\_far = nums[0]
 for num in nums[1:]:
 max\_here \*= num
 min\_here \*= num
 max\_here, min\_here = max(max\_here, min\_here, num), min(max\_here, min\_here, num)
 max\_so\_far = max(max\_here, max\_so\_far)
 return max\_so\_far

### 2.15. 判断一个数是否为2的幂次

[Leetcode 231. Power of Two](https://leetcode.com/problems/power-of-two/#/description)

def isPowerOfTwo(n):
 """
 :type n: int
 :rtype: bool
 """
 return n > 0 and 0x80000000 % n == 0

### 2.16. 判断一个数是否为4的幂次

[Leetcode 342. Power of Four](https://leetcode.com/problems/power-of-four/#/description)

def isPowerOfFour(num):
 """
 :type num: int
 :rtype: bool
 """
 return num > 0 and num & (num - 1) == 0 and num & 0x55555555 == num

### 2.17. 最近公共祖先问题

#### 2.17.1. 二叉树的最近公共祖先

[Leetcode 236. Lowest Common Ancestor of a Binary Tree](https://leetcode.com/problems/lowest-common-ancestor-of-a-binary-tree/description/)

public TreeNode lowestCommonAncestor(TreeNode root, TreeNode p, TreeNode q) {
 if (root == null || root == p || root == q) {
 return root;
 }
 TreeNode left = lowestCommonAncestor(root.left, p, q);
 TreeNode right = lowestCommonAncestor(root.right, p, q);
 if (left != null && right != null) {
 return root;
 }
 return left == null ? right : left;
}

#### 2.17.2. 二叉搜索树的最近公共祖先

[Leetcode 235. Lowest Common Ancestor of a Binary Search Tree](https://leetcode.com/problems/lowest-common-ancestor-of-a-binary-search-tree/description/)

public TreeNode lowestCommonAncestor(TreeNode root, TreeNode p, TreeNode q) {
 while (root != null) {
 if ((p.val < root.val && q.val > root.val)
 || (p.val > root.val && q.val < root.val)
 || p.val == root.val || q.val == root.val) {
 return root;
 }
 if (p.val < root.val && q.val < root.val) {
 root = root.left;
 }
 if (p.val > root.val && q.val > root.val) {
 root = root.right;
 }
 }
 return null;
}

### 2.18. 挑选数组中不连续的元素，使其和最大

[Leetcode 198. House Robber](https://leetcode.com/problems/house-robber/#/description)

public int rob(int[] nums) {
 if (nums.length == 0) {
 return 0;
 }
 int[] results = new int[nums.length + 1];
 results[0] = 0;
 results[1] = nums[0];
 for (int i = 2; i <= nums.length; i++) {
 results[i] = Math.max(nums[i - 1] + results[i - 2], results[i - 1]);
 }
 return results[nums.length];
}

### 2.19. 镜像二叉树

[Leetcode 101. Symmetric Tree](https://leetcode.com/problems/symmetric-tree/#/description)

def isSymmetric(root):
 """
 :type root: TreeNode
 :rtype: bool
 """

 def symmetric(left, right):
 if not left and not right:
 return True
 if left and right and left.val == right.val:
 return symmetric(left.left, right.right) and symmetric(left.right, right.left)
 return False

 if not root:
 return True
 return symmetric(root.left, root.right)

### 2.20. 判断二叉树是否平衡

[Leetcode 110. Balanced Binary Tree](https://leetcode.com/problems/balanced-binary-tree/#/description)

def isBalanced(root):
 """
 :type root: TreeNode
 :rtype: bool
 """

 def balanced(root):
 if not root:
 return 0
 left = balanced(root.left)
 right = balanced(root.right)
 if left == -1 or right == -1 or abs(left - right) > 1:
 return -1
 return 1 + max(left, right)

 return balanced(root) != -1

### 2.21. 二分法求平方根

[Leetcode 367. Valid Perfect Square](https://leetcode.com/problems/valid-perfect-square/#/description)

public int mySqrt(int x) {
 if (x == 0) {
 return 0;
 }
 int low = 1;
 int high = x;
 while (low <= high) {
 int mid = (low + high) / 2;
 if (mid <= x / mid) {
 low = mid + 1;
 } else {
 high = mid - 1;
 }
 }
 return low - 1;
}

### 2.22. n!求末尾0的个数

[Leetcode 172. Factorial Trailing Zeroes](https://leetcode.com/problems/factorial-trailing-zeroes/#/description)

public int trailingZeroes(int n) {
 int result = 0;
 long i = 5;
 while (i <= n) {
 result += n / i;
 i \*= 5;
 }
 return result;
}

### 2.23. 有序数组去重

[Leetcode 26. Remove Duplicates from Sorted Array](https://leetcode.com/problems/remove-duplicates-from-sorted-array/#/description)

def removeDuplicates(self, nums):
 """
 :type nums: List[int]
 :rtype: int
 """
 if not nums:
 return 0
 i = 0
 for j in range(1, len(nums)):
 if nums[j] != nums[i]:
 i += 1
 nums[i] = nums[j]
 return i + 1

### 2.24. 链表判断环

[Leetcode 141. Linked List Cycle](https://leetcode.com/problems/linked-list-cycle/#/description)

def hasCycle(head):
 """
 :type head: ListNode
 :rtype: bool
 """
 if head is None or head.next is None:
 return False
 walker = head
 runner = head.next
 while runner.next and runner.next.next:
 walker = walker.next
 runner = runner.next.next
 if walker == runner:
 return True
 return False

### 2.25. 有环链表获取环起始结点

[Leetcode 142. Linked List Cycle II](https://leetcode.com/problems/linked-list-cycle-ii/description/)

def detectCycle(head):
 """
 :type head: ListNode
 :rtype: ListNode
 """
 if head is None or head.next is None:
 return None
 walker = head
 runner = head
 while runner and runner.next:
 walker = walker.next
 runner = runner.next.next
 if walker == runner:
 break
 if runner is None:
 return None
 walker = head
 while walker != runner:
 walker = walker.next
 runner = runner.next
 return walker

### 2.26. 判断是否为回文数

[Leetcode 9. Palindrome Number](https://leetcode.com/problems/palindrome-number/#/description)

public boolean isPalindrome(int x) {
 if (x == 0) {
 return true;
 }
 if (x < 0 || x % 10 == 0) {
 return false;
 }
 int palindrome = 0;
 while (palindrome < x) {
 palindrome = palindrome \* 10 + x % 10;
 x /= 10;
 }
 return x == palindrome || x == palindrome / 10;
}

### 2.27. 是否存在二叉树根到叶子节点路径和为指定值

[Leetcode 112. Path Sum](https://leetcode.com/problems/path-sum/#/description)

def hasPathSum(root, sum):
 """
 :type root: TreeNode
 :type sum: int
 :rtype: bool
 """
 if root is None:
 return False
 if root.val == sum and root.left is None and root.right is None:
 return True

 return hasPathSum(root.left, sum - root.val) or hasPathSum(root.right, sum - root.val)

### 2.28. 找出字符串中所有变位词

[Leetcode 438. Find All Anagrams in a String](https://leetcode.com/problems/find-all-anagrams-in-a-string/#/description)

public List<Integer> findAnagrams(String s, String p) {
 List<Integer> list = new ArrayList<>();
 if (s == null || s.length() == 0 || p == null || p.length() == 0) return list;
 int[] hash = new int[256];
 for (char c : p.toCharArray()) {
 hash[c]++;
 }
 int left = 0, right = 0, count = p.length();
 while (right < s.length()) {
 if (hash[s.charAt(right)] >= 1) {
 count--;
 }
 hash[s.charAt(right)]--;
 right++;
 if (count == 0) {
 list.add(left);
 }
 if (right - left == p.length()) {
 if (hash[s.charAt(left)] >= 0) {
 count++;
 }
 hash[s.charAt(left)]++;
 left++;
 }
 }
 return list;
}

### 2.29. 判断两个字符串是否为同构字符串

[Leetcode 205. Isomorphic Strings](https://leetcode.com/problems/isomorphic-strings/#/description)

public boolean isIsomorphic(String s, String t) {
 int[] m1 = new int[256];
 int[] m2 = new int[256];
 for (int i = 0; i < s.length(); i++) {
 char k1 = s.charAt(i);
 char k2 = t.charAt(i);
 if (m1[k1] != m2[k2]) {
 return false;
 }
 m1[k1] = i + 1;
 m2[k2] = i + 1;
 }
 return true;
}

### 2.30. 判断一个数是否为其全部约数的和

[Leetcode 507. Perfect Number](https://leetcode.com/problems/perfect-number/#/description)

def checkPerfectNumber(num):
 """
 :type num: int
 :rtype: bool
 """
 if num == 1:
 return False
 result = 0
 i = 2
 while i \* i <= num:
 if num % i == 0:
 result += i
 result += num // i
 i += 1
 result += 1
 return result == num

### 2.31. 打乱数组元素

[Leetcode 384. Shuffle an Array](https://leetcode.com/problems/shuffle-an-array/#/description)

public void shuffle(int[] nums) {
 int length = nums.length;
 Random random = new Random();
 for (int i = 0; i < length; i++) {
 int swapIndex = random.nextInt(length);
 int temp = nums[i];
 nums[i] = nums[swapIndex];
 nums[swapIndex] = temp;
 }
 return nums;
}

### 2.32. 生成不重复随机序列

Random random = new Random();

public int[] randomSequence(int n) {
 int[] sequence = new int[n];
 int[] result = new int[n];
 for (int i = 0; i < n; i++) {
 sequence[i] = i;
 }
 int last = n - 1;
 for (int i = 0; i < n; i++) {
 int index = random.nextInt(last + 1);
 result[i] = sequence[index];
 sequence[index] = sequence[last];
 last--;
 }
 return result;
}

### 2.33. 使用随机生成0到5的函数，实现随机生成0到7的函数

Random random = new Random();

int random5(){
 return random.nextInt(6);
}
int random7(){
 while(true){
 int temp1=random5();
 int temp2=random5();
 int n=temp1\*6+temp2;
 if(n<8){
 return n;
 }
 }
}

### 2.34. 计算数组A、B、C、D中有多少种(i, j, k, l)使得A[i] + B[j] + C[k] + D[l] = 0

[Leetcode 454. 4Sum II](https://leetcode.com/problems/4sum-ii/#/description)

def fourSumCount(A, B, C, D):
 """
 :type A: List[int]
 :type B: List[int]
 :type C: List[int]
 :type D: List[int]
 :rtype: int
 """
 sumABDict = {}
 for a in A:
 for b in B:
 sumAB = a + b
 if sumAB not in sumABDict:
 sumABDict[sumAB] = 0
 sumABDict[sumAB] += 1
 result = 0
 for c in C:
 for d in D:
 sumCD = -c - d
 if sumCD in sumABDict:
 result += sumABDict[sumCD]
 return result

### 2.35. 计算给出的多个时间中，最小的时间差

[Leetcode 539. Minimum Time Difference](https://leetcode.com/problems/minimum-time-difference/#/description)

public int findMinDifference(List<String> timePoints) {
 boolean[] mark = new boolean[24 \* 60];
 for (String time : timePoints) {
 String[] t = time.split(":");
 int h = Integer.parseInt(t[0]);
 int m = Integer.parseInt(t[1]);
 if (mark[h \* 60 + m]) return 0;
 mark[h \* 60 + m] = true;
 }
 int prev = 0, min = Integer.MAX\_VALUE;
 int first = Integer.MAX\_VALUE, last = Integer.MIN\_VALUE;
 for (int i = 0; i < 24 \* 60; i++) {
 if (mark[i]) {
 if (first != Integer.MAX\_VALUE) {
 min = Math.min(min, i - prev);
 }
 first = Math.min(first, i);
 last = Math.max(last, i);
 prev = i;
 }
 }
 min = Math.min(min, (24 \* 60 - last + first));
 return min;
}

### 2.36. 计算[0, 10^n)中各位数字不同的数的个数

[Leetcode 357. Count Numbers with Unique Digits](https://leetcode.com/problems/count-numbers-with-unique-digits/#/description)

def countNumbersWithUniqueDigits(n):
 """
 :type n: int
 :rtype: int
 """
 if n == 0:
 return 1
 map = [None] \* (n + 1)
 map[1] = 10
 for i in range(2, n + 1):
 count = 9
 for j in range(9 - i + 2, 10):
 count \*= j
 map[i] = map[i - 1] + count
 return map[n]

### 2.37. 数组中仅有两个数仅出现一次，其余的数均出现两次，找出这两个数

[Leetcode 260. Single Number III](https://leetcode.com/problems/single-number-iii/#/description)

def singleNumber(nums):
 """
 :type nums: List[int]
 :rtype: List[int]
 """
 mixed\_xor = 0
 for num in nums:
 mixed\_xor ^= num
 diff = mixed\_xor & (mixed\_xor - 1) ^ mixed\_xor
 first = 0
 second = 0
 for num in nums:
 if diff & num:
 first ^= num
 else:
 second ^= num
 return [first, second]

### 2.38. 找出递增数列中第n位的数字

[Leetcode 400. Nth Digit](https://leetcode.com/problems/nth-digit/#/description)

def findNthDigit(n):
 """
 :type n: int
 :rtype: int
 """
 digits = 1
 start = 1
 length = 9
 while (n > digits \* length):
 n -= digits \* length
 digits += 1
 start \*= 10
 length \*= 10
 n -= 1
 number = start + n // digits
 return int(str(number)[n % digits])

### 2.39. 计算小于n的质数的个数

[Leetcode 204. Count Primes](https://leetcode.com/problems/count-primes/#/description)

def countPrimes(n):
 """
 :type n: int
 :rtype: int
 """
 if n < 2:
 return 0
 primes = [True] \* n
 primes[0] = False
 primes[1] = False
 for i in range(2, int(n \*\* 0.5) + 1):
 if primes[i]:
 for j in range(i \* i, n, i):
 primes[j] = False
 return sum(primes)

### 2.40. 由部分（可重复）给定数组元素相加得到指定值的情况数

[Leetcode 377. Combination Sum IV](https://leetcode.com/problems/combination-sum-iv/#/description)

public int combinationSum4(int[] nums, int target) {
 int[] results = new int[target + 1];
 results[0] = 1;
 for (int i = 1; i <= target; i++) {
 for (int num : nums) {
 if (i - num >= 0) {
 results[i] += results[i - num];
 }
 }
 }
 return results[target];
}

### 2.41. 在有序矩阵中寻找第k大的数

[Leetcode 378. Kth Smallest Element in a Sorted Matrix](https://leetcode.com/problems/kth-smallest-element-in-a-sorted-matrix/#/description)

public int kthSmallest(int[][] matrix, int k) {
 class Item {
 int value;
 int i;
 int j;

 public Item(int value, int i, int j) {
 this.value = value;
 this.i = i;
 this.j = j;
 }
 }
 int m = matrix.length;
 int n = matrix[0].length;
 PriorityQueue<Item> minHeap = new PriorityQueue<>(new Comparator<Item>() {
 @Override
 public int compare(Item o1, Item o2) {
 return o1.value - o2.value;
 }
 });
 for (int j = 0; j < n; j++) {
 minHeap.add(new Item(matrix[0][j], 0, j));
 }
 while (!minHeap.isEmpty()) {
 Item item = minHeap.poll();
 if (item.i < m - 1) {
 minHeap.add(new Item(matrix[item.i + 1][item.j], item.i + 1, item.j));
 }
 k--;
 if (k == 0) {
 return item.value;
 }
 }
 return 0;
}

### 2.42. 求n对括号的所有排列情况

[Leetcode 22. Generate Parentheses](https://leetcode.com/problems/generate-parentheses/#/description)

def generateParenthesis(n):
 """
 :type n: int
 :rtype: List[str]
 """

 def parenthesis(result, current, left, right):
 if left == 0 and right == 0:
 result.append(current)
 elif left >= 0 and right >= left:
 parenthesis(result, current + '(', left - 1, right)
 parenthesis(result, current + ')', left, right - 1)

 result = []
 parenthesis(result, '', n, n)
 return result

### 2.43. 给定字符串数组，求最大不相交的两个字符串的长度积

[Leetcode 318. Maximum Product of Word Lengths](https://leetcode.com/problems/maximum-product-of-word-lengths/#/description)

public int maxProduct(String[] words) {
 int[] bits = new int[words.length];
 int result = 0;
 for (int i = 0; i < words.length; i++) {
 int bit = 0;
 for (char letter : words[i].toCharArray()) {
 bit |= 1 << (letter - 'a');
 }
 bits[i] = bit;
 }
 for (int i = 0; i < bits.length; i++) {
 for (int j = i + 1; j < bits.length; j++) {
 if ((bits[i] & bits[j]) == 0 && words[i].length() \* words[j].length() > result) {
 result = words[i].length() \* words[j].length();
 }
 }
 }
 return result;
}

### 2.44. 在由[1, n]组成的长为n + 1的数组中，寻找重复的那个数

[Leetcode 287. Find the Duplicate Number](https://leetcode.com/problems/find-the-duplicate-number/#/description)

public int findDuplicate(int[] nums) {
 int low = 1;
 int high = nums.length - 1;
 while (low < high) {
 int mid = (low + high) / 2;
 int count = 0;
 for (int num : nums) {
 if (num <= mid) {
 count++;
 }
 }
 if (count <= mid) {
 low = mid + 1;
 } else {
 high = mid;
 }
 }
 return low;
}

### 2.45. 求给定数组的所有排列情况

[Leetcode 46. Permutations](https://leetcode.com/problems/permutations/#/description)

public List<List<Integer>> permute(int[] nums) {
 List<List<Integer>> result = new ArrayList<>();
 result.add(new ArrayList<>());
 for (int i = 0; i < nums.length; i++) {
 List<List<Integer>> newResult = new ArrayList<>();
 for (int j = 0; j <= i; j++) {
 for (List<Integer> item : result) {
 List<Integer> newItem = new ArrayList<>(item);
 newItem.add(j, nums[i]);
 newResult.add(newItem);
 }
 }
 result = newResult;
 }
 return result;
}

### 2.46. 求给定（元素可重复）数组的所有排列情况

[Leetcode 47. Permutations II](https://leetcode.com/problems/permutations-ii/description/)

def permuteUnique(self, nums):
 """
 :type nums: List[int]
 :rtype: List[List[int]]
 """
 result = []
 result.append([])
 for i, num in enumerate(nums):
 current\_result = []
 for item in result:
 for j in range(i + 1):
 if j > 0 and num == item[j - 1]:
 break
 temp = item[:]
 temp.insert(j, num)
 current\_result.append(temp)
 result = current\_result
 return result

### 2.47. 最长回文子序列

[Leetcode 516. Longest Palindromic Subsequence](https://leetcode.com/problems/longest-palindromic-subsequence/#/description)

public int longestPalindromeSubseq(String s) {
 int[][] dp = new int[s.length()][s.length()];
 for (int i = s.length() - 1; i >= 0; i--) {
 dp[i][i] = 1;
 for (int j = i + 1; j < s.length(); j++) {
 if (s.charAt(i) == s.charAt(j)) {
 dp[i][j] = dp[i + 1][j - 1] + 2;
 } else {
 dp[i][j] = Math.max(dp[i + 1][j], dp[i][j - 1]);
 }
 }
 }
 return dp[0][s.length() - 1];
}

### 2.48. 将[1, n]的数按字典排序

[Leetcode 386. Lexicographical Numbers](https://leetcode.com/problems/lexicographical-numbers/#/description)

def lexicalOrder(n):
 """
 :type n: int
 :rtype: List[int]
 """

 def dfs(result, current, n):
 if current > n:
 return
 result.append(current)
 current \*= 10
 if current <= n:
 for i in range(10):
 if current + i <= n:
 dfs(result, current + i, n)

 result = []
 for i in range(1, 10):
 dfs(result, i, n)
 return result

### 2.49. 二叉搜索树迭代器

[Leetcode 173. Binary Search Tree Iterator](https://leetcode.com/problems/binary-search-tree-iterator/#/description)

class BSTIterator(object):
 def \_\_init\_\_(self, root):
 """
 :type root: TreeNode
 """
 self.stack = []
 while root:
 self.stack.append(root)
 root = root.left

 def hasNext(self):
 """
 :rtype: bool
 """
 return self.stack

 def next(self):
 """
 :rtype: int
 """
 node = self.stack.pop()
 result = node.val
 node = node.right
 while node:
 self.stack.append(node)
 node = node.left
 return result

### 2.50. 由[1, n]组成的二叉搜索树的个数

[Leetcode 96. Unique Binary Search Trees](https://leetcode.com/problems/unique-binary-search-trees/#/description)

public int numTrees(int n) {
 int[] results = new int[n + 1];
 results[0] = 1;
 for (int i = 1; i <= n; i++) {
 for (int j = 0; j < i; j++) {
 results[i] += results[j] \* results[i - j - 1];
 }
 }
 return results[n];
}

### 2.51. 格雷码

[Leetcode 89. Gray Code](https://leetcode.com/problems/gray-code/#/description)

def grayCode(n):
 """
 :type n: int
 :rtype: List[int]
 """
 return [i ^ (i >> 1) for i in range(1 << n)]

### 2.52. 从m x n棋盘左上角走到右下角的路径总数

[Leetcode 62. Unique Paths](https://leetcode.com/problems/unique-paths/#/description)

public int uniquePaths(int m, int n) {
 int[][] dp = new int[m][n];
 for (int i = 0; i < m; i++) {
 dp[i][0] = 1;
 }
 for (int j = 0; j < n; j++) {
 dp[0][j] = 1;
 }
 for (int i = 1; i < m; i++) {
 for (int j = 1; j < n; j++) {
 dp[i][j] = dp[i - 1][j] + dp[i][j - 1];
 }
 }
 return dp[m - 1][n - 1];
}

### 2.53. 求集合的所有子集

[Leetcode 78. Subsets](https://leetcode.com/problems/subsets/#/description)

def subsets(nums):
 """
 :type nums: List[int]
 :rtype: List[List[int]]
 """
 result = []
 for i in range(1 << len(nums)):
 current = []
 for j in range(len(nums)):
 if i & 1 << j:
 current.append(nums[j])
 result.append(current)
 return result

### 2.54. 求（元素可重复）集合的所有子集

[Leetcode 90. Subsets II](https://leetcode.com/problems/subsets-ii/description/)

def subsetsWithDup(self, nums):
 """
 :type nums: List[int]
 :rtype: List[List[int]]
 """
 result = [[]]
 nums.sort()
 last\_start = 0
 for i, num in enumerate(nums):
 start = last\_start if (i > 0 and nums[i] == nums[i - 1]) else 0
 last\_start = len(result)
 for item in result[start:last\_start]:
 temp = item[:]
 temp.append(num)
 result.append(temp)
 return result

### 2.55. 判断数组arr中是否存在arr[i] < arr[j] < arr[k]

[Leetcode 334. Increasing Triplet Subsequence](https://leetcode.com/problems/increasing-triplet-subsequence/#/description)

public boolean increasingTriplet(int[] nums) {
 int first = Integer.MAX\_VALUE;
 int second = Integer.MAX\_VALUE;
 for (int num : nums) {
 if (num < first) {
 first = num;
 } else if (num < second && num > first) {
 second = num;
 } else if (num > second) {
 return true;
 }
 }
 return false;
}

### 2.56. 查找数组中第k大的数

[Leetcode 215. Kth Largest Element in an Array](https://leetcode.com/problems/kth-largest-element-in-an-array/#/description)

def find\_kth\_largest(nums, k):
 def partition(array, low, high):
 pivot = array[low]
 while low < high:
 while low < high and array[high] >= pivot:
 high -= 1
 array[low] = array[high]
 while low < high and array[low] <= pivot:
 low += 1
 array[high] = array[low]
 array[low] = pivot
 return low

 random.shuffle(nums)
 k = len(nums) - k
 low = 0
 high = len(nums) - 1
 while low < high:
 index = partition(nums, low, high)
 if index < k:
 low = index + 1
 elif index > k:
 high = index - 1
 else:
 break
 return nums[k]

### 2.57. 链表删除倒数第n个结点

[Leetcode 19. Remove Nth Node From End of List](https://leetcode.com/problems/remove-nth-node-from-end-of-list/#/description)

def removeNthFromEnd(head, n):
 """
 :type head: ListNode
 :type n: int
 :rtype: ListNode
 """
 first = head
 second = head
 prev = head
 while n:
 first = first.next
 n -= 1
 while first:
 first = first.next
 prev = second
 second = second.next
 if second == head:
 return head.next
 prev.next = prev.next.next
 return head

### 2.58. 判断数组是否可以拼接为正方形

[Leetcode 473. Matchsticks to Square](https://leetcode.com/problems/matchsticks-to-square/#/description)

public boolean makesquare(int[] nums) {
 class Utils {
 boolean square(int[] nums, int[] edges, int start) {
 if (start == nums.length) {
 return edges[0] == 0 && edges[1] == 0 && edges[2] == 0 && edges[3] == 0;
 }
 int current = nums[start];
 for (int i = 0; i < edges.length; i++) {
 if (edges[i] >= current) {
 edges[i] -= current;
 if (square(nums, edges, start + 1)) {
 return true;
 }
 edges[i] += current;
 }
 }
 return false;
 }
 }
 if (nums.length < 4) {
 return false;
 }
 int sumNums = 0;
 for (int num : nums) {
 sumNums += num;
 }
 if (sumNums % 4 != 0) {
 return false;
 }
 int[] edges = new int[4];
 Arrays.fill(edges, sumNums / 4);
 Arrays.sort(nums);
 for (int left = 0, right = nums.length - 1; left < right; left++, right--) {
 int temp = nums[left];
 nums[left] = nums[right];
 nums[right] = temp;
 }
 Utils utils = new Utils();
 return utils.square(nums, edges, 0);
}

### 2.59. 快速pow()

[Leetcode 372. Super Pow](https://leetcode.com/problems/super-pow/#/description)

public int normalPow(int a, int b) {
 int result = 1;
 while (b != 0) {
 if (b % 2 != 0)
 result = result \* a % M;
 a = a \* a % M;
 b /= 2;
 }
 return result;
}

public int superPow(int a, int[] b) {
 a %= M;
 int result = 1;
 for (int i = b.length - 1; i >= 0; i--) {
 result = result \* normalPow(a, b[i]) % M;
 a = normalPow(a, 10);
 }
 return result;

### 2.60. 判断数组是否可以分为相等的两部分

[Leetcode 416. Partition Equal Subset Sum](https://leetcode.com/problems/partition-equal-subset-sum/#/description)

public boolean canPartition(int[] nums) {
 int target = 0;
 for (int num : nums) {
 target += num;
 }
 if (target % 2 == 1) {
 return false;
 }
 target /= 2;
 boolean[][] dp = new boolean[nums.length + 1][target + 1];
 dp[0][0] = true;
 for (int i = 1; i <= nums.length; i++) {
 for (int j = 0; j <= target; j++) {
 dp[i][j] = dp[i - 1][j];
 if (j >= nums[i - 1]) {
 dp[i][j] = dp[i][j] || dp[i - 1][j - nums[i - 1]];
 }
 }
 }
 return dp[nums.length][target];
}

### 2.61. 在矩阵中查找指定值

[Leetcode 240. Search a 2D Matrix II](https://leetcode.com/problems/search-a-2d-matrix-ii/#/description)

def searchMatrix(matrix, target):
 """
 :type matrix: List[List[int]]
 :type target: int
 :rtype: bool
 """
 if not matrix:
 return False
 i = 0
 j = len(matrix[0]) - 1
 while i < len(matrix) and j >= 0:
 current = matrix[i][j]
 if current == target:
 return True
 elif current > target:
 j -= 1
 else:
 i += 1
 return False

### 2.62. 将矩阵顺时针旋转90度

[Leetcode 48. Rotate Image](https://leetcode.com/problems/rotate-image/#/description)

def rotate(matrix):
 """
 :type matrix: List[List[int]]
 :rtype: void Do not return anything, modify matrix in-place instead.
 """
 m = len(matrix)
 n = len(matrix[0])
 for i in range(m // 2):
 matrix[i], matrix[m - i - 1] = matrix[m - i - 1], matrix[i]
 for i in range(m):
 for j in range(i + 1, n):
 matrix[i][j], matrix[j][i] = matrix[j][i], matrix[i][j]

### 2.63. 最长递增子序列

[Leetcode 300. Longest Increasing Subsequence](https://leetcode.com/problems/longest-increasing-subsequence/#/description)

def lengthOfLIS(nums):
 """
 :type nums: List[int]
 :rtype: int
 """
 if not nums:
 return 0
 dp = [1] \* len(nums)
 for i in range(1, len(nums)):
 for j in range(i):
 if nums[i] > nums[j]:
 dp[i] = max(dp[i], dp[j] + 1)

 return max(dp)

### 2.64. 求二维矩阵由左上角到右下角的最小和

[Leetcode 64. Minimum Path Sum](https://leetcode.com/problems/minimum-path-sum/#/description)

public int minPathSum(int[][] grid) {
 int m = grid.length;
 int n = grid[0].length;
 int[][] dp = new int[m][n];
 dp[0][0] = grid[0][0];
 for (int i = 1; i < m; i++) {
 dp[i][0] = dp[i - 1][0] + grid[i][0];
 }
 for (int j = 1; j < n; j++) {
 dp[0][j] = dp[0][j - 1] + grid[0][j];
 }
 for (int i = 1; i < m; i++) {
 for (int j = 1; j < n; j++) {
 dp[i][j] = Math.min(dp[i - 1][j], dp[i][j - 1]) + grid[i][j];
 }
 }
 return dp[m - 1][n - 1];
}

### 2.65. 将由0、1、2组成的数组排序

[Leetcode 75. Sort Colors](https://leetcode.com/problems/sort-colors/#/description)

def sortColors(self, nums):
 """
 :type nums: List[int]
 :rtype: void Do not return anything, modify nums in-place instead.
 """
 left = 0
 right = len(nums) - 1
 middle = 0
 while middle <= right:
 while nums[middle] == 2 and middle < right:
 nums[middle], nums[right] = nums[right], nums[middle]
 right -= 1
 while nums[middle] == 0 and middle > left:
 nums[middle], nums[left] = nums[left], nums[middle]
 left += 1
 middle += 1

### 2.66. 求第n位仅由指定因数组成的数字

[Leetcode 313. Super Ugly Number](https://leetcode.com/problems/super-ugly-number/#/description)

public int nthSuperUglyNumber(int n, int[] primes) {
 int[] factors = new int[primes.length];
 Arrays.fill(factors, 1);
 int[] indexes = new int[primes.length];
 Arrays.fill(indexes, -1);
 int[] ugly = new int[n];
 for (int i = 0; i < n; i++) {
 int theMin = Integer.MAX\_VALUE;
 for (int factor : factors) {
 theMin = Math.min(theMin, factor);
 }
 ugly[i] = theMin;
 for (int j = 0; j < factors.length; j++) {
 if (ugly[i] == factors[j]) {
 indexes[j]++;
 factors[j] = ugly[indexes[j]] \* primes[j];
 }
 }
 }
 return ugly[ugly.length - 1];
}

### 2.67. 数组中查找极大值

[Leetcode 162. Find Peak Elementr](https://leetcode.com/problems/find-peak-element/description/)

public int findPeakElement(int[] nums) {
 if (nums.length == 1 || nums[0] > nums[1]) {
 return 0;
 }
 if (nums[nums.length - 2] < nums[nums.length - 1]) {
 return nums.length - 1;
 }
 int low = 0;
 int high = nums.length - 1;
 while (low < high) {
 int mid = (low + high) / 2;
 if (nums[mid] < nums[mid + 1]) {
 low = mid + 1;
 } else {
 high = mid;
 }
 }
 return low;
}

### 2.68. 判断n能否由平方数的和组成

[Leetcode 279. Perfect Squares](https://leetcode.com/problems/perfect-squares/#/description)

def numSquares(self, n):
 """
 :type n: int
 :rtype: int
 """
 dp = [n] \* (n + 1)
 dp[0] = 0
 for i in range(1, n + 1):
 j = 1
 while j \* j <= i:
 dp[i] = min(dp[i], dp[i - j \* j] + 1)
 j += 1
 return dp[n]

### 2.69. 删除二叉搜索树中的结点

[Leetcode 450. Delete Node in a BST](https://leetcode.com/problems/delete-node-in-a-bst/#/description)

def deleteNode(root, key):
 """
 :type root: TreeNode
 :type key: int
 :rtype: TreeNode
 """
 if not root:
 return None
 if root.val > key:
 root.left = deleteNode(root.left, key)
 elif root.val < key:
 root.right = deleteNode(root.right, key)
 else:
 if not root.left:
 return root.right
 elif not root.right:
 return root.left
 else:
 replace = root.right
 while replace.left:
 replace = replace.left
 root.val = replace.val
 root.right = deleteNode(root.right, root.val)
 return root

### 2.70. 检查字符串是否是合法的二叉树前序遍历结果

[Leetcode 331. Verify Preorder Serialization of a Binary Tree](https://leetcode.com/problems/verify-preorder-serialization-of-a-binary-tree/#/description)

def isValidSerialization(self, preorder):
 """
 :type preorder: str
 :rtype: bool
 """
 degree = -1
 for node in preorder.split(','):
 degree += 1
 if degree > 0:
 return False
 if node != '#':
 degree -= 2
 return degree == 0

### 2.71. 中缀表达式转后缀表达式

String infixToPostfix(String infix) {
 Map<Character, Integer> priority = new HashMap<>();
 priority.put('(', 1);
 priority.put(')', -1);
 priority.put('+', 2);
 priority.put('-', 2);
 priority.put('\*', 3);
 priority.put('/', 3);
 priority.put('^', 3);
 StringBuilder builder = new StringBuilder();
 Stack<Character> stack = new Stack<>();
 for (char c : infix.toCharArray()) {
 if (priority.containsKey(c)) {
 if (c == '(') {
 stack.push(c);
 } else if (c == ')') {
 while (!stack.empty() && stack.peek() != '(') {
 builder.append(stack.pop());
 }
 if (!stack.empty()) {
 stack.pop();
 }
 } else {
 while (!stack.empty() && priority.get(stack.peek()) >= priority.get(c)) {
 builder.append(stack.pop());
 }
 stack.push(c);
 }
 } else {
 builder.append(c);
 }
 }
 while (!stack.empty()) {
 builder.append(stack.pop());
 }
 return builder.toString();
}

### 2.72. 排列的下一种情况

[Leetcode 31. Next Permutation](https://leetcode.com/problems/next-permutation/description/)

def nextPermutation(self, nums):
 """
 :type nums: List[int]
 :rtype: void Do not return anything, modify nums in-place instead.
 """
 i = len(nums) - 2
 while i >= 0 and nums[i] >= nums[i + 1]:
 i -= 1
 if i < 0:
 nums.sort()
 return
 j = len(nums) - 1
 while nums[j] <= nums[i]:
 j -= 1
 nums[i], nums[j] = nums[j], nums[i]
 nums[i + 1:] = sorted(nums[i + 1:])

### 2.73. 求旋转有序数组的最小值

[Leetcode 153. Find Minimum in Rotated Sorted Array](https://leetcode.com/problems/find-minimum-in-rotated-sorted-array/description/)

def findMin(self, nums):
 """
 :type nums: List[int]
 :rtype: int
 """
 length = len(nums)
 low = 0
 high = length - 1
 while low < high:
 mid = (low + high) // 2
 if nums[mid] > nums[high]:
 low = mid + 1
 else:
 high = mid
 return nums[low]

### 2.74. 在旋转有序数组中查找指定值

[Leetcode 33. Search in Rotated Sorted Array](https://leetcode.com/problems/search-in-rotated-sorted-array/description/)

def search(self, nums, target):
 """
 :type nums: List[int]
 :type target: int
 :rtype: int
 """
 length = len(nums)
 low = 0
 high = length - 1
 while low < high:
 mid = (low + high) // 2
 if nums[mid] > nums[high]:
 low = mid + 1
 else:
 high = mid
 rotate = low
 low = 0
 high = length - 1
 while low <= high:
 mid = (low + high) // 2
 real\_mid = (mid + rotate) % length
 if nums[real\_mid] == target:
 return real\_mid
 if nums[real\_mid] < target:
 low = mid + 1
 else:
 high = mid - 1
 return -1

### 2.75. 在旋转（元素可重复）有序数组中查找指定值

[Leetcode 81. Search in Rotated Sorted Array II](https://leetcode.com/problems/search-in-rotated-sorted-array-ii/description/)

def search(self, nums, target):
 """
 :type nums: List[int]
 :type target: int
 :rtype: bool
 """
 if not nums:
 return False
 low = 0
 high = len(nums) - 1
 while low < high:
 mid = (low + high) // 2
 if nums[mid] == target:
 return True
 if nums[mid] > nums[high]:
 if nums[low] <= target < nums[mid]:
 high = mid
 else:
 low = mid + 1
 elif nums[mid] < nums[high]:
 if nums[mid] < target <= nums[high]:
 low = mid + 1
 else:
 high = mid
 else:
 high -= 1
 return nums[low] == target

### 2.76. 有序数组中查找特定元素的第一个和最后一个索引

[Leetcode 34. Search for a Range](https://leetcode.com/problems/search-for-a-range/description/)

def searchRange(self, nums, target):
 """
 :type nums: List[int]
 :type target: int
 :rtype: List[int]
 """

 def search(nums, target):
 low = 0
 high = len(nums) - 1
 while low <= high:
 mid = (low + high) // 2
 if nums[mid] < target:
 low = mid + 1
 else:
 high = mid - 1
 return low

 if not nums:
 return [-1, -1]
 low = search(nums, target)
 if low == len(nums) or nums[low] != target:
 return [-1, -1]
 high = search(nums, target + 1)
 high -= 1
 return [low, high]

### 2.77. 有序数组中查找指定值的插入位置

[Leetcode 35. Search Insert Position](https://leetcode.com/problems/search-insert-position/description/)

def searchInsert(self, nums, target):
 """
 :type nums: List[int]
 :type target: int
 :rtype: int
 """
 low = 0
 high = len(nums) - 1
 while low < high:
 mid = (low + high) // 2
 if nums[mid] == target:
 return mid
 if nums[mid] > target:
 high = mid - 1
 else:
 low = mid + 1
 return low

### 2.78. 实现pow(x, n)

[Leetcode 50. Pow(x, n)](https://leetcode.com/problems/powx-n/description/)

def myPow(self, x, n):
 """
 :type x: float
 :type n: int
 :rtype: float
 """
 if not n:
 return 1
 if n < 0:
 n = -n
 x = 1 / x
 if n % 2:
 return x \* myPow(x \* x, n // 2)
 return myPow(x \* x, n // 2)

### 2.79. 第k个排列

[Leetcode 60. Permutation Sequence](https://leetcode.com/problems/permutation-sequence/description/)

def getPermutation(self, n, k):
 """
 :type n: int
 :type k: int
 :rtype: str
 """
 factor = [0] \* n
 factor[0] = 1
 for i in range(1, n):
 factor[i] = factor[i - 1] \* i
 result = ''
 k -= 1
 numbers = [i for i in range(1, 10)]
 for i in range(n - 1, -1, -1):
 number = k // factor[i]
 k %= factor[i]
 result += str(numbers[number])
 del numbers[number]
 return result

### 2.80. 链表向右循环移动k个位置

[Leetcode 61. Rotate List](https://leetcode.com/problems/rotate-list/description/)

def rotateRight(self, head, k):
 """
 :type head: ListNode
 :type k: int
 :rtype: ListNode
 """
 if not head:
 return head
 tail = head
 length = 1
 while tail.next:
 tail = tail.next
 length += 1
 if k % length:
 tail.next = head
 step = length - k%length - 1
 new\_head = head
 for i in range(step):
 new\_head = new\_head.next
 head = new\_head.next
 new\_head.next = None
 return head

### 2.81. 先序遍历和中序遍历构建二叉树

[Leetcode 105. Construct Binary Tree from Preorder and Inorder Traversal](https://leetcode.com/problems/construct-binary-tree-from-preorder-and-inorder-traversal/description/)

def buildTree(self, preorder, inorder):
 """
 :type preorder: List[int]
 :type inorder: List[int]
 :rtype: TreeNode
 """
 if not preorder or not inorder:
 return None
 node = TreeNode(preorder.pop(0))
 index = inorder.index(node.val)
 node.left = buildTree(preorder, inorder[:index])
 node.right = buildTree(preorder, inorder[index + 1:])
 return node

### 2.82. 中序遍历和后序遍历构建二叉树

[Leetcode 106. Construct Binary Tree from Inorder and Postorder Traversal](https://leetcode.com/problems/construct-binary-tree-from-inorder-and-postorder-traversal/description/)

def buildTree(self, inorder, postorder):
 """
 :type inorder: List[int]
 :type postorder: List[int]
 :rtype: TreeNode
 """
 if not inorder or not postorder:
 return None
 node = TreeNode(postorder.pop())
 index\_inorder = inorder.index(node.val)
 node.right = buildTree(inorder[index\_inorder + 1:], postorder)
 node.left = buildTree(inorder[:index\_inorder], postorder)
 return node

### 2.83. 求杨辉三角第k行的值

[Leetcode 119. Pascal's Triangle II](https://leetcode.com/problems/pascals-triangle-ii/description/)

def getRow(self, rowIndex):
 """
 :type rowIndex: int
 :rtype: List[int]
 """
 result = [0] \* (rowIndex + 1)
 result[0] = 1
 for row in range(1, rowIndex + 1):
 for i in range(row, 0, -1):
 result[i] += result[i - 1]
 return result

### 2.84. 克隆图

[Leetcode 133. Clone Graph](https://leetcode.com/problems/clone-graph/description/)

def cloneGraph(self, node):
 def clone(node, memory):
 if node.label not in memory:
 copy = UndirectedGraphNode(node.label)
 memory[copy.label] = copy
 for neighbor in node.neighbors:
 copy.neighbors.append(clone(neighbor, memory))
 return memory[node.label]
 if not node:
 return node
 memory = {}
 return clone(node, memory)

### 2.85. 查找数组中的极大值元素

[Leetcode 162. Find Peak Element](https://leetcode.com/problems/find-peak-element/description/)

def findPeakElement(self, nums):
 """
 :type nums: List[int]
 :rtype: int
 """
 if len(nums) == 1 or nums[0] > nums[1]:
 return 0
 if nums[-2] < nums[-1]:
 return len(nums) - 1
 low = 0
 high = len(nums) - 1
 while low < high:
 mid = (low + high) // 2
 if nums[mid] < nums[mid + 1]:
 low = mid + 1
 else:
 high = mid
 return low

### 2.86. 将数组合并拼接为最大的数

[Leetcode 179. Largest Number](https://leetcode.com/problems/largest-number/description/)

def largestNumber(self, nums):
 strs = [str(num) for num in nums]
 strs.sort(lambda x, y: 1 if x + y < y + x else -1 if x + y > y + x else 0)
 if strs[0] == '0':
 return '0'
 return ''.join(strs)

### 2.87. 计算完全二叉树的结点数

[Leetcode 222. Count Complete Tree Nodes](https://leetcode.com/problems/count-complete-tree-nodes/description/)

def countNodes(self, root):
 """
 :type root: TreeNode
 :rtype: int
 """
 if not root:
 return 0
 depth\_left = 0
 node\_left = root
 while node\_left:
 depth\_left += 1
 node\_left = node\_left.left
 depth\_right = 0
 node\_right = root
 while node\_right:
 depth\_right += 1
 node\_right = node\_right.right
 if depth\_left == depth\_right:
 return 2 \*\* depth\_left - 1
 return 1 + self.countNodes(root.left) + self.countNodes(root.right)

### 2.88. 加减乘除（无括号）计算器

[Leetcode 227. Basic Calculator II](https://leetcode.com/problems/basic-calculator-ii/description/)

def calculate(self, s):
 """
 :type s: str
 :rtype: int
 """
 result = 0
 pre\_number = 0
 pre\_operator = '+'
 i = 0
 while i < len(s):
 while i < len(s) and s[i] == ' ':
 i += 1
 current = 0
 while i < len(s) and s[i] >= '0' and s[i] <= '9':
 current = current \* 10 + ord(s[i]) - ord('0')
 i += 1
 if pre\_operator == '+':
 result += pre\_number
 pre\_number = current
 elif pre\_operator == '-':
 result += pre\_number
 pre\_number = -current
 elif pre\_operator == '\*':
 pre\_number \*= current
 else:
 temp = pre\_number
 pre\_number /= current
 if temp < 0 and temp % current:
 pre\_number += 1
 while i < len(s) and s[i] == ' ':
 i += 1
 if i < len(s):
 pre\_operator = s[i]
 i += 1
 result += pre\_number
 return result

### 2.89. 加减（带括号）计算器

[Leetcode 224. Basic Calculator](https://leetcode.com/problems/basic-calculator/description/)

def calculate(self, s):
 """
 :type s: str
 :rtype: int
 """
 stack = []
 result = 0
 current = 0
 sign = 1
 for letter in s:
 if letter.isdigit():
 current = current \* 10 + ord(letter) - ord('0')
 elif letter in ['+', '-']:
 result += sign \* current
 current = 0
 sign = 1 if letter == '+' else -1
 elif letter == '(':
 stack.append(result)
 stack.append(sign)
 sign = 1
 result = 0
 elif letter == ')':
 result += sign \* current
 result \*= stack.pop()
 result += stack.pop()
 current = 0
 result += sign \* current
 return result

### 2.90. 二叉搜索树中第k小的数

[Leetcode 230. Kth Smallest Element in a BST](https://leetcode.com/problems/kth-smallest-element-in-a-bst/description/)

def kthSmallest(self, root, k):
 """
 :type root: TreeNode
 :type k: int
 :rtype: int
 """
 self.k = k
 self.result = None

 def smallest(root):
 if not root:
 return
 smallest(root.left)
 self.k -= 1
 if not self.k:
 self.result = root.val
 return
 smallest(root.right)

 smallest(root)
 return self.result

### 2.91. 求（元素可更新）数组指定区间的和

[Leetcode 307. Range Sum Query - Mutable](https://leetcode.com/problems/range-sum-query-mutable/description/)

class NumArray(object):
 class Node:
 def \_\_init\_\_(self, start, end):
 self.start = start
 self.end = end
 self.left = None
 self.right = None
 self.sum = 0

 def build(self, nums, start, end):
 if start > end:
 return None
 node = self.Node(start, end)
 if start == end:
 node.sum = nums[start]
 else:
 mid = (start + end) // 2
 node.left = self.build(nums, start, mid)
 node.right = self.build(nums, mid + 1, end)
 node.sum = node.left.sum + node.right.sum
 return node

 def \_\_init\_\_(self, nums):
 """
 :type nums: List[int]
 """
 self.root = self.build(nums, 0, len(nums) - 1)

 def update(self, i, val):
 """
 :type i: int
 :type val: int
 :rtype: void
 """

 def upd(node, i, val):
 if node.start == node.end:
 node.sum = val
 else:
 mid = (node.start + node.end) // 2
 if i <= mid:
 upd(node.left, i, val)
 else:
 upd(node.right, i, val)
 node.sum = node.left.sum + node.right.sum

 upd(self.root, i, val)

 def sumRange(self, i, j):
 """
 :type i: int
 :type j: int
 :rtype: int
 """

 def sum\_ran(node, start, end):
 if node.start == start and node.end == end:
 return node.sum
 mid = (node.start + node.end) // 2
 if end <= mid:
 return sum\_ran(node.left, start, end)
 if start > mid:
 return sum\_ran(node.right, start, end)
 return sum\_ran(node.left, start, mid) + sum\_ran(node.right, mid + 1, end)

 return sum\_ran(self.root, i, j)

### 2.92. 求数组中任意两个元素异或的最大值

[Leetcode 421. Maximum XOR of Two Numbers in an Array](https://leetcode.com/problems/maximum-xor-of-two-numbers-in-an-array/description/)

def findMaximumXOR(self, nums):
 """
 :type nums: List[int]
 :rtype: int
 """
 result = 0
 mask = 0
 for i in range(31, -1, -1):
 mask |= 1 << i
 nums\_set = set()
 for num in nums:
 nums\_set.add(num & mask)
 current = result | (1 << i)
 for num in nums\_set:
 if num ^ current in nums\_set:
 result = current
 break
 return result

### 2.93. 二叉搜索树的序列化和反序列化

[Leetcode 449. Serialize and Deserialize BST](https://leetcode.com/problems/serialize-and-deserialize-bst/description/)

class Codec:

 def serialize(self, root):
 """Encodes a tree to a single string.

 :type root: TreeNode
 :rtype: str
 """
 result = ''
 stack = []
 while root or stack:
 if root:
 result += str(root.val) + ' '
 stack.append(root)
 root = root.left
 else:
 node = stack.pop()
 root = node.right
 return result

 def deserialize(self, data):
 """Decodes your encoded data to tree.

 :type data: str
 :rtype: TreeNode
 """
 data = [int(item) for item in data.split()]

 def construct(data, i, j):
 if i == j:
 return None
 node = TreeNode(data[i])
 split\_index = i + 1
 while split\_index < j and data[split\_index] < data[i]:
 split\_index += 1
 node.left = construct(data, i + 1, split\_index)
 node.right = construct(data, split\_index, j)
 return node

 return construct(data, 0, len(data))

### 2.94. 轮流取数判断先取者是否必胜

[Leetcode 486. Predict the Winner](https://leetcode.com/problems/predict-the-winner/description/)

def PredictTheWinner(self, nums):
 """
 :type nums: List[int]
 :rtype: bool
 """

 def predict(nums, start, end, first, second):
 if start > end:
 return first >= second
 return not predict(nums, start + 1, end, second, first + nums[start]) \
 or not predict(nums, start, end - 1, second, first + nums[end])

 if len(nums) <= 1:
 return True
 return predict(nums, 0, len(nums) - 1, 0, 0)

### 2.95. 一串数加上分别加上加号或减号使其结果等于指定值

[Leetcode 494. Target Sum](https://leetcode.com/problems/target-sum/description/)

def findTargetSumWays(self, nums, S):
 """
 :type nums: List[int]
 :type S: int
 :rtype: int
 """
 sum\_nums = sum(nums)
 if S > sum\_nums or S < -sum\_nums:
 return 0
 map = [0] \* (2 \* sum\_nums + 1)
 map[sum\_nums] = 1
 for num in nums:
 new\_map = [0] \* (2 \* sum\_nums + 1)
 for i in range(2 \* sum\_nums + 1):
 if map[i]:
 new\_map[i + num] += map[i]
 new\_map[i - num] += map[i]
 map = new\_map
 return map[sum\_nums + S]

### 2.96. 有序数组中除一个数仅出现一次外，其他数均出现两次，求这个数

[Leetcode 540. Single Element in a Sorted Array](https://leetcode.com/problems/single-element-in-a-sorted-array/description/)

def singleNonDuplicate(self, nums):
 """
 :type nums: List[int]
 :rtype: int
 """
 low = 0
 high = len(nums) - 1
 while low < high:
 mid = (low + high) // 2
 if (mid % 2 == 0 and nums[mid] == nums[mid + 1]) or (mid % 2 != 0 and nums[mid] == nums[mid - 1]):
 low = mid + 1
 else:
 high = mid - 1
 return nums[low]

### 2.97. 最长任意元素差最大为1的子序列

[Leetcode 594. Longest Harmonious Subsequence](https://leetcode.com/problems/longest-harmonious-subsequence/description/)

def findLHS(self, nums):
 """
 :type nums: List[int]
 :rtype: int
 """
 memory = {}
 for num in nums:
 if num not in memory:
 memory[num] = 0
 memory[num] += 1
 result = 0
 for key, value in memory.items():
 if key + 1 in memory:
 result = max(result, value + memory[key + 1])
 return result

### 2.98. 数组中寻找任意三个元素的最大积

[Leetcode 628. Maximum Product of Three Numbers](https://leetcode.com/problems/maximum-product-of-three-numbers/description/)

def maximumProduct(self, nums):
 """
 :type nums: List[int]
 :rtype: int
 """
 max\_1 = -sys.maxsize
 max\_2 = -sys.maxsize
 max\_3 = -sys.maxsize
 min\_1 = sys.maxsize
 min\_2 = sys.maxsize
 for num in nums:
 if num > max\_1:
 max\_3 = max\_2
 max\_2 = max\_1
 max\_1 = num
 elif num > max\_2:
 max\_3 = max\_2
 max\_2 = num
 elif num > max\_3:
 max\_3 = num
 if num < min\_1:
 min\_2 = min\_1
 min\_1 = num
 elif num < min\_2:
 min\_2 = num
 return max(max\_1 \* max\_2 \* max\_3, max\_1 \* min\_1 \* min\_2)

### 2.99. 生成结点个数为n的所有二叉搜索树

[Leetcode 95. Unique Binary Search Trees II](https://leetcode.com/problems/unique-binary-search-trees-ii/description/)

def generateTrees(self, n):
 """
 :type n: int
 :rtype: List[TreeNode]
 """
 def generate(start, end):
 result = []
 if start > end:
 return [None]
 for i in range(start, end + 1):
 lefts = generate(start, i - 1)
 rights = generate(i + 1, end)
 for left in lefts:
 for right in rights:
 root = TreeNode(i)
 root.left = left
 root.right = right
 result.append(root)
 return result

 if n == 0:
 return []
 return generate(1, n)

### 2.100. 数组中除一个数仅出现一次外，其他数均出现三次，求这个数

[Leetcode 137. Single Number II](https://leetcode.com/problems/single-number-ii/description/)

def singleNumber(self, nums):
 """
 :type nums: List[int]
 :rtype: int
 """
 x1 = 0
 x2 = 0
 for num in nums:
 x2 ^= x1 & num
 x1 ^= num
 mask = ~(x1 & x2)
 x2 &= mask
 x1 &= mask
 return x1

### 2.101. 将一个数拆分为多个数的和，并使这些数的积最大

[Leetcode 343. Integer Break](https://leetcode.com/problems/integer-break/description/)

def integerBreak(self, n):
 """
 :type n: int
 :rtype: int
 """
 if n == 2:
 return 1
 if n == 3:
 return 2
 if n == 4:
 return 4
 result = 1
 while n > 4:
 n -= 3
 result \*= 3
 if n == 4:
 result \*= 4
 elif n == 3:
 result \*= 3
 elif n == 2:
 result \*= 2
 return result

### 2.102. 轮流取数先取者是否必胜

[Leetcode 464. Can I Win](https://leetcode.com/problems/can-i-win/description/)

def canIWin(self, maxChoosableInteger, desiredTotal):
 """
 :type maxChoosableInteger: int
 :type desiredTotal: int
 :rtype: bool
 """
 def to\_key(choosed):
 result = 1
 for item in choosed:
 result <<= 1
 if item:
 result |= 1
 return result

 def win(choosed, memory, total):
 key = to\_key(choosed)
 if key in memory:
 return memory[key]
 for i in range(1, len(choosed)):
 if not choosed[i]:
 choosed[i] = True
 if total <= i or not win(choosed, memory, total - i):
 memory[key] = True
 choosed[i] = False
 return True
 choosed[i] = False
 memory[key] = False
 return False

 if desiredTotal == 0:
 return True
 if (1 + maxChoosableInteger) \* maxChoosableInteger // 2 < desiredTotal:
 return False
 return win([False] \* (maxChoosableInteger + 1), {}, desiredTotal)

### 2.103. 区间调度问题

#### 2.103.1. 最多区间调度

[Leetcode 633. Sum of Square Numbers](https://leetcode.com/problems/sum-of-square-numbers/description/)

def maxNonoverlapIntervals(self, intervals):
 """
 :type points: List[List[int]]
 :rtype: int
 """
 intervals.sort(key=lambda interval: interval[1])
 current\_start = -sys.maxsize
 result = 0
 for interval in intervals:
 if interval[0] > current\_start:
 current\_start = interval[1]
 result += 1
 return result

### 2.104. 寻找数组中是否存在nums[i]和nums[j]差的绝对值最大为t，i和j差的绝对值最大为k

[Leetcode 220. Contains Duplicate III](https://leetcode.com/problems/contains-duplicate-iii/description/)

def containsNearbyAlmostDuplicate(self, nums, k, t):
 """
 :type nums: List[int]
 :type k: int
 :type t: int
 :rtype: bool
 """
 if k < 1 or t < 0:
 return False
 buckets = {}
 for i, num in enumerate(nums):
 adjusted\_num = num + 0x80000000
 bucket = adjusted\_num // (t + 1)
 if bucket in buckets \
 or (bucket - 1 in buckets and abs(adjusted\_num - buckets[bucket - 1]) <= t) \
 or (bucket + 1 in buckets and abs(adjusted\_num - buckets[bucket + 1]) <= t):
 return True
 buckets[bucket] = adjusted\_num
 if i >= k:
 del buckets[(nums[i - k] + 0x80000000) // (t + 1)]
 return False

### 2.105. 猜数游戏，猜错需要付钱，求确保猜中的最小代价

[Leetcode 375. Guess Number Higher or Lower II](https://leetcode.com/problems/guess-number-higher-or-lower-ii/description/)

def getMoneyAmount(self, n):
 """
 :type n: int
 :rtype: int
 """
 def get\_money(start, end, memory):
 if start >= end:
 return 0
 if memory[start][end] != 0:
 return memory[start][end]
 result = sys.maxsize
 for i in range(start, end + 1):
 current = i + max(get\_money(start, i - 1, memory), get\_money(i + 1, end, memory))
 result = min(result, current)
 memory[start][end] = result
 return result

 memory = [[0] \* (n + 1) for \_ in range(n + 1)]
 return get\_money(0, n, memory)

### 2.106. 寻找数组中是否存在i < j < k使得ai < ak < aj

[Leetcode 456. 132 Pattern](https://leetcode.com/problems/132-pattern/description/)

def find132pattern(self, nums):
 """
 :type nums: List[int]
 :rtype: bool
 """
 if len(nums) < 3:
 return False
 stack = []
 for num in nums:
 if not stack or stack[-1][0] > num:
 stack.append((num, num))
 elif stack[-1][0] < num:
 if stack[-1][1] > num:
 return True
 the\_min = stack[-1][0]
 stack.pop()
 while stack and stack[-1][1] <= num:
 stack.pop()
 if stack and stack[-1][0] < num:
 return True
 stack.append((the\_min, num))
 return False

### 2.107. 矩阵上从某一点经过最多N次移动出界外的路径总数

[Leetcode 576. Out of Boundary Paths](https://leetcode.com/problems/out-of-boundary-paths/description/)

def findPaths(self, m, n, N, i, j):
 """
 :type m: int
 :type n: int
 :type N: int
 :type i: int
 :type j: int
 :rtype: int
 """
 dp = [[[0] \* (n) for \_ in range(m)] for \_ in range(N + 1)]
 moves = ((-1, 0), (1, 0), (0, -1), (0, 1))
 for k in range(1, N + 1):
 for a in range(m):
 for b in range(n):
 for move in moves:
 row = a + move[0]
 col = b + move[1]
 if row == -1 or col == -1 or row == m or col == n:
 dp[k][a][b] += 1
 else:
 dp[k][a][b] += dp[k - 1][row][col]
 dp[k][a][b] %= 1000000007
 return dp[N][i][j]

### 2.108. 每次操作删除一个字符，求使得两个字符串相同的最少操作次数

[Leetcode 583. Delete Operation for Two Strings](https://leetcode.com/problems/delete-operation-for-two-strings/description/)

def minDistance(self, word1, word2):
 """
 :type word1: str
 :type word2: str
 :rtype: int
 """
 l1 = len(word1)
 l2 = len(word2)
 dp = [[0] \* (l2 + 1) for \_ in range(l1 + 1)]
 for i in range(1, l1 + 1):
 for j in range(1, l2 + 1):
 if word1[i - 1] == word2[j - 1]:
 dp[i][j] = dp[i - 1][j - 1] + 1
 else:
 dp[i][j] = max(dp[i][j - 1], dp[i - 1][j])
 max\_length = dp[l1][l2]
 return l1 - max\_length + l2 - max\_length

### 2.109. 求字符串的（不同下标）回文字串的数目

[Leetcode 647. Palindromic Substrings](https://leetcode.com/problems/palindromic-substrings/description/)

def countSubstrings(self, s):
 """
 :type s: str
 :rtype: int
 """
 self.result = 0

 def count(s, left, right):
 while left >= 0 and right < len(s) and s[left] == s[right]:
 self.result += 1
 left -= 1
 right += 1

 for i in range(len(s)):
 count(s, i, i)
 count(s, i, i + 1)
 return self.result

### 2.110. 打印二叉树

[Leetcode 655. Print Binary Tree](https://leetcode.com/problems/print-binary-tree/description/)

def printTree(self, root):
 """
 :type root: TreeNode
 :rtype: List[List[str]]
 """
 def get\_depth(root):
 if not root:
 return 0
 return max(get\_depth(root.left), get\_depth(root.right)) + 1

 depth = get\_depth(root)
 self.result = [[''] \* (2 \*\* depth - 1) for \_ in range(depth)]

 def print\_tree(root, row, depth, col):
 self.result[row][col] = str(root.val)
 row += 1
 if root.left:
 print\_tree(root.left, row, depth, col - 2 \*\* (depth - row - 1))
 if root.right:
 print\_tree(root.right, row, depth, col + 2 \*\* (depth - row - 1))

 print\_tree(root, 0, depth, 2 \*\* (depth - 1) - 1)
 return self.result

### 2.111. 是否可以仅改变一个元素，使得数组为单调递增数组

[Leetcode 665. Non-decreasing Array](https://leetcode.com/problems/non-decreasing-array/description/)

def checkPossibility(self, nums):
 """
 :type nums: List[int]
 :rtype: bool
 """
 is\_modified = False
 for i in range(1, len(nums)):
 if nums[i - 1] > nums[i]:
 if is\_modified:
 return False
 is\_modified = True
 if i < 2 or nums[i - 2] <= nums[i]:
 nums[i - 1] = nums[i]
 else:
 nums[i] = nums[i - 1]
 return True

### 2.112. 仅调换一次一个数的两个数字，求最大值

[Leetcode 670. Maximum Swap](https://leetcode.com/problems/maximum-swap/description/)

def maximumSwap(self, num):
 """
 :type num: int
 :rtype: int
 """
 num\_str = list(str(num))
 last\_index = {}
 for i, item in enumerate(num\_str):
 last\_index[item] = i
 for i, item in enumerate(num\_str):
 for digit in '987654321':
 if digit > item and digit in last\_index and last\_index[digit] > i:
 num\_str[i], num\_str[last\_index[digit]] = num\_str[last\_index[digit]], num\_str[i]
 return int(''.join(num\_str))
 return num

### 2.113. 检查带有通配符的括号序列是否合法

[Leetcode 678. Valid Parenthesis String](https://leetcode.com/problems/valid-parenthesis-string/description/)

def checkValidString(self, s):
 """
 :type s: str
 :rtype: bool
 """
 min\_close = 0
 max\_close = 0
 for letter in s:
 if letter == '(':
 min\_close += 1
 max\_close += 1
 elif letter == ')':
 if min\_close > 0:
 min\_close -= 1
 max\_close -= 1
 if max\_close < 0:
 return False
 else:
 if min\_close > 0:
 min\_close -= 1
 max\_close += 1
 return min\_close == 0

### 2.114. 两个有序数组的中位数

[Leetcode 4. Median of Two Sorted Arrays](https://leetcode.com/problems/median-of-two-sorted-arrays/description/)

def findMedianSortedArrays(self, nums1, nums2):
 """
 :type nums1: List[int]
 :type nums2: List[int]
 :rtype: float
 """
 if len(nums1) > len(nums2):
 return self.findMedianSortedArrays(nums2, nums1)
 short\_length = len(nums1)
 long\_length = len(nums2)
 short\_left = 0
 short\_right = len(nums1)
 while short\_left <= short\_right:
 short\_mid = (short\_left + short\_right) // 2
 long\_mid = (short\_length + long\_length + 1) // 2 - short\_mid
 if short\_mid < short\_length and nums1[short\_mid] < nums2[long\_mid - 1]:
 short\_left = short\_mid + 1
 elif short\_mid > 0 and nums1[short\_mid - 1] > nums2[long\_mid]:
 short\_right = short\_mid - 1
 else:
 max\_left = None
 if short\_mid == 0:
 max\_left = nums2[long\_mid - 1]
 elif long\_mid == 0:
 max\_left = nums1[short\_mid - 1]
 else:
 max\_left = max(nums1[short\_mid - 1], nums2[long\_mid - 1])
 if (short\_length + long\_length) % 2:
 return max\_left
 min\_right = None
 if short\_mid == short\_length:
 min\_right = nums2[long\_mid]
 elif long\_mid == long\_length:
 min\_right = nums1[short\_mid]
 else:
 min\_right = min(nums1[short\_mid], nums2[long\_mid])
 return (max\_left + min\_right) / 2.0

### 2.115. 带有.和\*的正则表达式匹配

[Leetcode 10. Regular Expression Matching](https://leetcode.com/problems/regular-expression-matching/description/)

def isMatch(self, s, p):
 """
 :type s: str
 :type p: str
 :rtype: bool
 """
 length\_s = len(s)
 length\_p = len(p)
 dp = [[False] \* (length\_p + 1) for i in range(length\_s + 1)]
 dp[0][0] = True
 for i in range(1, length\_s + 1):
 dp[i][0] = False
 for j in range(1, length\_p + 1):
 dp[0][j] = j > 1 and p[j - 1] == '\*' and dp[0][j - 2]
 for i in range(1, length\_s + 1):
 for j in range(1, length\_p + 1):
 if p[j - 1] == '\*':
 dp[i][j] = dp[i][j - 2] or ((p[j - 2] == s[i - 1] or p[j - 2] == '.') and dp[i - 1][j])
 else:
 dp[i][j] = dp[i - 1][j - 1] and (p[j - 1] == s[i - 1] or p[j - 1] == '.')
 return dp[length\_s][length\_p]

### 2.116. 合并多个有序链表

[Leetcode 23. Merge k Sorted Lists](https://leetcode.com/problems/merge-k-sorted-lists/description/)

# Definition for singly-linked list.
# class ListNode(object):
# def \_\_init\_\_(self, x):
# self.val = x
# self.next = None

def mergeKLists(self, lists):
 """
 :type lists: List[ListNode]
 :rtype: ListNode
 """
 def partition(lists, start, end):
 if start == end:
 return lists[start]
 if start < end:
 mid = (start + end) // 2
 list\_1 = partition(lists, start, mid)
 list\_2 = partition(lists, mid + 1, end)
 return merge(list\_1, list\_2)
 return None

 def merge(list\_1, list\_2):
 fake\_head = ListNode(0)
 current = fake\_head
 while list\_1 and list\_2:
 if list\_1.val < list\_2.val:
 current.next = list\_1
 list\_1 = list\_1.next
 else:
 current.next = list\_2
 list\_2 = list\_2.next
 current = current.next
 current.next = list\_1 if list\_1 else list\_2
 return fake\_head.next

 return partition(lists, 0, len(lists) - 1)

### 2.117. 最长合法括号字串

[Leetcode 32. Longest Valid Parentheses](https://leetcode.com/problems/longest-valid-parentheses/description/)

def longestValidParentheses(self, s):
 """
 :type s: str
 :rtype: int
 """
 left = 0
 right = 0
 result = 0
 for item in s:
 if item == '(':
 left += 1
 else:
 right += 1
 if left == right:
 result = max(result, left + right)
 elif left < right:
 left = 0
 right = 0
 left = 0
 right = 0
 for item in reversed(s):
 if item == '(':
 left += 1
 else:
 right += 1
 if left == right:
 result = max(result, left + right)
 elif left > right:
 left = 0
 right = 0
 return result

### 2.118. 带有?和\*的正则表达式匹配

[Leetcode 44. Wildcard Matching](https://leetcode.com/problems/wildcard-matching/description/)

def isMatch(self, s, p):
 """
 :type s: str
 :type p: str
 :rtype: bool
 """
 length\_s = len(s)
 length\_p = len(p)
 dp = [[False] \* (length\_p + 1) for i in range(length\_s + 1)]
 dp[0][0] = True
 for j in range(1, length\_p + 1):
 dp[0][j] = dp[0][j - 1] and p[j - 1] == '\*'
 for i in range(1, length\_s + 1):
 for j in range(1, length\_p + 1):
 if p[j - 1] == '\*':
 dp[i][j] = dp[i - 1][j] or dp[i][j - 1]
 else:
 dp[i][j] = dp[i - 1][j - 1] and (p[j - 1] == s[i - 1] or p[j - 1] == '?')
 return dp[length\_s][length\_p]

### 2.119. 检查字符串是否是合法数字

[Leetcode 65. Valid Number](https://leetcode.com/problems/valid-number/description/)

def isNumber(self, s):
 """
 :type s: str
 :rtype: bool
 """
 s = s.strip()
 has\_dot = False
 has\_e = False
 has\_number = False
 has\_number\_after\_e = False
 for i, letter in enumerate(s):
 if letter in '0123456789':
 has\_number = True
 if has\_e:
 has\_number\_after\_e = True
 elif letter == '.':
 if has\_dot or has\_e:
 return False
 has\_dot = True
 elif letter == 'e':
 if has\_e or not has\_number:
 return False
 has\_e = True
 elif letter in '+-':
 if i != 0 and s[i - 1] != 'e':
 return False
 else:
 return False
 return (not has\_e ^ has\_number\_after\_e) and has\_number

### 2.120. 通过插入、删除和替换，最少需要多少次操作可以使得两个字符串相同

[Leetcode 72. Edit Distance](https://leetcode.com/problems/edit-distance/description/)

def minDistance(self, word1, word2):
 """
 :type word1: str
 :type word2: str
 :rtype: int
 """
 m = len(word1)
 n = len(word2)
 dp = [[0] \* (n + 1) for i in range(m + 1)]
 for i in range(m + 1):
 dp[i][0] = i
 for j in range(n + 1):
 dp[0][j] = j
 for i in range(1, m + 1):
 for j in range(1, n + 1):
 if word1[i - 1] == word2[j - 1]:
 dp[i][j] = dp[i - 1][j - 1]
 else:
 dp[i][j] = min(dp[i - 1][j - 1], dp[i][j - 1], dp[i - 1][j]) + 1
 return dp[m][n]

### 2.121. 柱状图中的最大矩形

[Leetcode 84. Largest Rectangle in Histogram](https://leetcode.com/problems/largest-rectangle-in-histogram/description/)

def largestRectangleArea(self, heights):
 """
 :type heights: List[int]
 :rtype: int
 """
 stack = []
 i = 0
 result = 0
 while i < len(heights):
 while stack and heights[i] < heights[stack[-1]]:
 index = stack.pop()
 current = heights[index] \* (i - (stack[-1] if stack else -1) - 1)
 result = max(result, current)
 stack.append(i)
 i += 1
 while stack:
 index = stack.pop()
 current = heights[index] \* (i - (stack[-1] if stack else -1) - 1)
 result = max(result, current)
 return result

### 2.122. 矩阵中由1组成的最大矩阵

[Leetcode 85. Maximal Rectangle](https://leetcode.com/problems/maximal-rectangle/description/)

def maximalRectangle(self, matrix):
 """
 :type matrix: List[List[str]]
 :rtype: int
 """
 if not matrix:
 return 0
 heights = [0] \* len(matrix[0])
 result = 0
 for row in matrix:
 for i, item in enumerate(row):
 if item == '1':
 heights[i] += 1
 else:
 heights[i] = 0
 stack = []
 i = 0
 while i < len(heights):
 while stack and heights[i] < heights[stack[-1]]:
 index = stack.pop()
 current = heights[index] \* (i - (stack[-1] if stack else -1) - 1)
 result = max(result, current)
 stack.append(i)
 i += 1
 while stack:
 index = stack.pop()
 current = heights[index] \* (i - (stack[-1] if stack else -1) - 1)
 result = max(result, current)
 return result

### 2.123. 判断字符串是否由给定的两个字符串组合而成

[Leetcode 97. Interleaving String](https://leetcode.com/problems/interleaving-string/description/)

def isInterleave(self, s1, s2, s3):
 """
 :type s1: str
 :type s2: str
 :type s3: str
 :rtype: bool
 """
 length\_1 = len(s1) + 1
 length\_2 = len(s2) + 1
 if len(s1) + len(s2) != len(s3):
 return False
 dp = [[False] \* length\_2 for i in range(length\_1)]
 dp[0][0] = True
 for i in range(1, length\_1):
 dp[i][0] = dp[i - 1][0] and s1[i - 1] == s3[i - 1]
 for j in range(1, length\_2):
 dp[0][j] = dp[0][j - 1] and s2[j - 1] == s3[j - 1]
 for i in range(1, length\_1):
 for j in range(1, length\_2):
 dp[i][j] = (dp[i - 1][j] and s1[i - 1] == s3[i + j - 1]) or (
 dp[i][j - 1] and s2[j - 1] == s3[i + j - 1])
 return dp[length\_1 - 1][length\_2 - 1]

### 2.124. 一个字符串有多少个子序列可以组成另一个字符串

[Leetcode 115. Distinct Subsequences](https://leetcode.com/problems/distinct-subsequences/description/)

def numDistinct(self, s, t):
 """
 :type s: str
 :type t: str
 :rtype: int
 """
 dp = [[None] \* (len(s) + 1) for i in range(len(t) + 1)]
 dp[0] = [1] \* (len(s) + 1)
 for i in range(1, len(t) + 1):
 dp[i][0] = 0
 for i in range(1, len(t) + 1):
 for j in range(1, len(s) + 1):
 dp[i][j] = dp[i][j - 1]
 if t[i - 1] == s[j - 1]:
 dp[i][j] += dp[i - 1][j - 1]
 return dp[len(t)][len(s)]

### 2.125. 二叉树上最大（不需要经过根结点）路径和

[Leetcode 124. Binary Tree Maximum Path Sum](https://leetcode.com/problems/binary-tree-maximum-path-sum/description/)

def maxPathSum(self, root):
 """
 :type root: TreeNode
 :rtype: int
 """
 def path\_sum(root, result):
 if not root:
 return (0, result)
 left, result = path\_sum(root.left, result)
 left = max(0, left)
 right, result = path\_sum(root.right, result)
 right = max(0, right)
 result = max(result, left + right + root.val)
 return max(left, right) + root.val, result

 return path\_sum(root, -sys.maxsize)[1]

### 2.126. 求将字符串切分为回文字串需要的最少切分次数

[Leetcode 132. Palindrome Partitioning II](https://leetcode.com/problems/palindrome-partitioning-ii/description/)

def minCut(self, s):
 """
 :type s: str
 :rtype: int
 """
 length = len(s)
 cuts = [0] \* length
 palindrome = [[False] \* length for i in range(length)]
 for i in range(length):
 current = i
 for j in range(i + 1):
 if s[i] == s[j] and (i - j < 2 or palindrome[j + 1][i - 1]):
 palindrome[j][i] = True
 current = 0 if j == 0 else min(current, cuts[j - 1] + 1)
 cuts[i] = current
 return cuts[length - 1]

### 2.127. 二维坐标系下一条线上最多多少个点

[Leetcode 149. Max Points on a Line](https://leetcode.com/problems/max-points-on-a-line/description/)

def maxPoints(self, points):
 """
 :type points: List[Point]
 :rtype: int
 """
 def transform(a, b):
 def gcd(a, b):
 while b:
 a, b = b, a % b
 return a

 c = gcd(a, b)
 a /= c
 b /= c
 return (a << 32) | b

 if len(points) < 3:
 return len(points)
 result = 0
 for i, current in enumerate(points):
 same\_point = 1
 same\_vertical\_line = 0
 memory = {}
 for j in range(i + 1, len(points)):
 point = points[j]
 if current.x == point.x and current.y == point.y:
 same\_point += 1
 elif current.x == point.x:
 same\_vertical\_line += 1
 else:
 key = transform(point.y - current.y, point.x - current.x)
 if key not in memory:
 memory[key] = 0
 memory[key] += 1
 result = max(result, same\_vertical\_line + same\_point)
 if memory:
 result = max(result, max(memory.values()) + same\_point)
 return result

### 2.128. 股票交易求最大收益，最多可以进行k次交易

[Leetcode 188. Best Time to Buy and Sell Stock IV](https://leetcode.com/problems/best-time-to-buy-and-sell-stock-iv/description/)

def maxProfit(self, k, prices):
 """
 :type k: int
 :type prices: List[int]
 :rtype: int
 """
 if not prices:
 return 0
 if k >= len(prices) // 2:
 result = 0
 for i in range(1, len(prices)):
 if prices[i] > prices[i - 1]:
 result += prices[i] - prices[i - 1]
 return result
 dp = [0] \* len(prices)
 for time in range(k):
 current = dp[0] - prices[0]
 for i in range(1, len(prices)):
 current = max(current, dp[i] - prices[i])
 dp[i] = max(dp[i - 1], prices[i] + current)
 return max(dp)

### 2.129. 在字符串前插入一些字符使得字符串为回文字符串、

[Leetcode 214. Shortest Palindrome](https://leetcode.com/problems/shortest-palindrome/description/)

def shortestPalindrome(self, s):
 """
 :type s: str
 :rtype: str
 """
 reverse = s[::-1]
 for i in range(len(s) + 1):
 if s.startswith(reverse[i:]):
 return reverse[:i] + s

### 2.130. 计算从1到n中含有数字1的数的个数

[Leetcode 233. Number of Digit One](https://leetcode.com/problems/number-of-digit-one/description/)

def countDigitOne(self, n):
 """
 :type n: int
 :rtype: int
 """
 result = 0
 times = 1
 while times <= n:
 a = n // times
 b = n % times
 if a % 10 == 0:
 result += a // 10 \* times
 elif a % 10 == 1:
 result += a // 10 \* times + b + 1
 else:
 result += (a // 10 + 1) \* times
 times \*= 10
 return result

### 2.131. 移动窗口求每个窗口元素最大值

[Leetcode 239. Sliding Window Maximum](https://leetcode.com/problems/sliding-window-maximum/description/)

def maxSlidingWindow(self, nums, k):
 """
 :type nums: List[int]
 :type k: int
 :rtype: List[int]
 """
 que = collections.deque()
 result = []
 for i, num in enumerate(nums):
 if que and que[0] == i - k:
 que.popleft()
 while que and nums[que[-1]] < num:
 que.pop()
 que.append(i)
 if i + 1 >= k:
 result.append(nums[que[0]])
 return result

### 2.132. 数字转换为英文单词组合

[Leetcode 273. Integer to English Words](https://leetcode.com/problems/integer-to-english-words/description/)

def numberToWords(self, num):
 """
 :type num: int
 :rtype: str
 """
 def convert(num):
 LESS\_THAN\_20 = ["", "One", "Two", "Three", "Four", "Five", "Six", "Seven", "Eight", "Nine", "Ten", "Eleven",
 "Twelve", "Thirteen", "Fourteen", "Fifteen", "Sixteen", "Seventeen", "Eighteen", "Nineteen"]
 TENS = ["", "Ten", "Twenty", "Thirty", "Forty", "Fifty", "Sixty", "Seventy", "Eighty", "Ninety"]
 if num == 0:
 return ''
 if num < 20:
 return LESS\_THAN\_20[num] + ' '
 if num < 100:
 return TENS[num // 10] + ' ' + convert(num % 10)
 return LESS\_THAN\_20[num // 100] + ' Hundred ' + convert(num % 100)

 THOUSANDS = ["", "Thousand", "Million", "Billion"]
 if num == 0:
 return 'Zero'
 i = 0
 result = ''
 while num:
 slice = num % 1000
 if slice:
 result = convert(slice) + THOUSANDS[i] + ' ' + result
 num //= 1000
 i += 1
 return result.strip()

### 2.133. 二叉树的序列化和反序列化

[Leetcode 273. Integer to English Words](https://leetcode.com/problems/integer-to-english-words/description/)

class Codec:

 def serialize(self, root):
 """Encodes a tree to a single string.

 :type root: TreeNode
 :rtype: str
 """

 def serial(node, result):
 if node:
 result.append(str(node.val))
 serial(node.left, result)
 serial(node.right, result)
 else:
 result.append('#')

 result = []
 serial(root, result)
 return ' '.join(result)

 def deserialize(self, data):
 """Decodes your encoded data to tree.

 :type data: str
 :rtype: TreeNode
 """

 def deserail(que):
 value = que.popleft()
 if value == '#':
 return None
 node = TreeNode(int(value))
 node.left = deserail(que)
 node.right = deserail(que)
 return node

 que = collections.deque(data.split())
 return deserail(que)

### 2.134. 移除字符串中的重复字符，并使得最终结果字典序最小

[Leetcode 316. Remove Duplicate Letters](https://leetcode.com/problems/remove-duplicate-letters/description/)

def removeDuplicateLetters(self, s):
 """
 :type s: str
 :rtype: str
 """
 stack = []
 counts = [0] \* 128
 for letter in s:
 counts[ord(letter)] += 1
 exists = [False] \* 128
 for letter in s:
 letter\_in\_int = ord(letter)
 counts[letter\_in\_int] -= 1
 if exists[letter\_in\_int]:
 continue
 while stack and letter\_in\_int < stack[-1] and counts[stack[-1]] > 0:
 temp = stack.pop()
 exists[temp] = False
 stack.append(letter\_in\_int)
 exists[letter\_in\_int] = True
 return ''.join(map(chr, stack))

### 2.135. 信封俄罗斯套娃

[Leetcode 354. Russian Doll Envelopes](https://leetcode.com/problems/russian-doll-envelopes/description/)

def maxEnvelopes(self, envelopes):
 """
 :type envelopes: List[List[int]]
 :rtype: int
 """
 envelopes.sort(key=lambda x: (x[0], -x[1]))
 dp = [0] \* len(envelopes)
 current\_length = 0
 for envelope in envelopes:
 low = 0
 high = current\_length
 value = envelope[1]
 while low < high:
 mid = (low + high) // 2
 if dp[mid] == value:
 low = mid
 break
 if dp[mid] < value:
 low = mid + 1
 else:
 high = mid
 dp[low] = value
 if low == current\_length:
 current\_length += 1
 return current\_length

### 2.136. 小矩阵是否能完整拼接为大矩阵

[Leetcode 391. Perfect Rectangle](https://leetcode.com/problems/perfect-rectangle/description/)

def isRectangleCover(self, rectangles):
 """
 :type rectangles: List[List[int]]
 :rtype: bool
 """
 x1 = sys.maxsize
 y1 = sys.maxsize
 x2 = -sys.maxsize
 y2 = -sys.maxsize
 got = set()
 sum\_up = 0
 for rectangle in rectangles:
 a1 = rectangle[0]
 b1 = rectangle[1]
 a2 = rectangle[2]
 b2 = rectangle[3]
 x1 = min(x1, a1)
 y1 = min(y1, b1)
 x2 = max(x2, a2)
 y2 = max(y2, b2)
 sum\_up += (a2 - a1) \* (b2 - b1)
 for i in [0, 2]:
 for j in [1, 3]:
 key = str(rectangle[i]) + ' ' + str(rectangle[j])
 if key in got:
 got.remove(key)
 else:
 got.add(key)
 return len(got) == 4 \
 and (str(x1) + ' ' + str(y1)) in got \
 and (str(x1) + ' ' + str(y2)) in got \
 and (str(x2) + ' ' + str(y1)) in got \
 and (str(x2) + ' ' + str(y2)) in got \
 and sum\_up == (x2 - x1) \* (y2 - y1)

### 2.137. 将数组划分为m份，使得每份和的最大值最小

[Leetcode 410. Split Array Largest Sum](https://leetcode.com/problems/split-array-largest-sum/description/)

def splitArray(self, nums, m):
 """
 :type nums: List[int]
 :type m: int
 :rtype: int
 """
 def cut(nums, mid, m):
 count = 1
 current\_sum = 0
 for num in nums:
 current\_sum += num
 if current\_sum > mid:
 count += 1
 current\_sum = num
 if count > m:
 return False
 return True

 low = max(nums)
 high = sum(nums)
 while low <= high:
 mid = (low + high) // 2
 cuts = cut(nums, mid, m)
 if cuts:
 high = mid - 1
 else:
 low = mid + 1
 return low

### 2.138. 在1到n中寻找字典序第k小的数

[Leetcode 440. K-th Smallest in Lexicographical Order](https://leetcode.com/problems/k-th-smallest-in-lexicographical-order/description/)

def findKthNumber(self, n, k):
 """
 :type n: int
 :type k: int
 :rtype: int
 """
 current = 1
 k -= 1
 while k > 0:
 steps = 0
 start = current
 end = start + 1
 while start <= n:
 steps += min(n + 1, end) - start
 start \*= 10
 end \*= 10
 if steps <= k:
 current += 1
 k -= steps
 else:
 current \*= 10
 k -= 1
 return current

### 2.139. 滑动窗口中间值

[Leetcode 480. Sliding Window Median](https://leetcode.com/problems/sliding-window-median/description/)

def medianSlidingWindow(self, nums, k):
 """
 :type nums: List[int]
 :type k: int
 :rtype: List[float]
 """
 min\_heap = []
 max\_heap = []
 result = []

 for i, num in enumerate(nums[:k]):
 heapq.heappush(max\_heap, (-num, i))
 for \_ in range(k - k // 2):
 heapq.heappush(min\_heap, (-max\_heap[0][0], max\_heap[0][1]))
 heapq.heappop(max\_heap)
 for i in range(k, len(nums)):
 num = nums[i]
 result.append(min\_heap[0][0] / 1.0 if k % 2 else (min\_heap[0][0] - max\_heap[0][0]) / 2.0)
 if num >= min\_heap[0][0]:
 heapq.heappush(min\_heap, (num, i))
 if nums[i - k] <= min\_heap[0][0]:
 heapq.heappush(max\_heap, (-min\_heap[0][0], min\_heap[0][1]))
 heapq.heappop(min\_heap)
 else:
 heapq.heappush(max\_heap, (-num, i))
 if nums[i - k] >= min\_heap[0][0]:
 heapq.heappush(min\_heap, (-max\_heap[0][0], max\_heap[0][1]))
 heapq.heappop(max\_heap)
 while max\_heap and max\_heap[0][1] <= i - k:
 heapq.heappop(max\_heap)
 while min\_heap and min\_heap[0][1] <= i - k:
 heapq.heappop(min\_heap)
 result.append(min\_heap[0][0] / 1.0 if k % 2 else (min\_heap[0][0] - max\_heap[0][0]) / 2.0)
 return result

### 2.140. 多个有序数组，每个数组挑选至少一个数，求能够组成的最小的数组范围

[Leetcode 632. Smallest Range](https://leetcode.com/problems/smallest-range/description/)

def smallestRange(self, nums):
 """
 :type nums: List[List[int]]
 :rtype: List[int]
 """
 heap = []
 end = -sys.maxsize
 for index, num in enumerate(nums):
 end = max(end, num[0])
 heapq.heappush(heap, (num[0], index, 0))
 start = heap[0][0]
 temp\_end = end
 while len(heap) == len(nums):
 current = heapq.heappop(heap)
 if current[2] + 1 < len(nums[current[1]]):
 temp\_end = max(temp\_end, nums[current[1]][current[2] + 1])
 heapq.heappush(heap, (nums[current[1]][current[2] + 1], current[1], current[2] + 1))
 if temp\_end - heap[0][0] < end - start:
 start = heap[0][0]
 end = temp\_end
 return [start, end]

### 2.141. 点游戏

[Leetcode 679. 24 Game](https://leetcode.com/problems/24-game/description/)

def judgePoint24(self, nums):
 """
 :type nums: List[int]
 :rtype: bool
 """
 EPS = 0.001

 def back\_trace(nums):
 if len(nums) == 1:
 return abs(nums[0] - 24) < EPS
 for i, a in enumerate(nums):
 for j, b in enumerate(nums[:i]):
 candidates = [a + b, a - b, b - a, a \* b]
 if abs(a) > EPS:
 candidates.append(b / a)
 if abs(b) > EPS:
 candidates.append(a / b)
 del nums[i]
 del nums[j]
 for candidate in candidates:
 nums.append(candidate)
 if back\_trace(nums):
 return True
 nums.pop()
 nums.insert(j, b)
 nums.insert(i, a)
 return False

 return back\_trace(nums)

### 2.142. 数组中寻找三个长为k的不重叠子数组，使得其和最大

[Leetcode 689. Maximum Sum of 3 Non-Overlapping Subarrays](https://leetcode.com/problems/maximum-sum-of-3-non-overlapping-subarrays/description/)

def maxSumOfThreeSubarrays(self, nums, k):
 """
 :type nums: List[int]
 :type k: int
 :rtype: List[int]
 """
 length = len(nums)
 left\_sums = []
 temp = 0
 left\_sums.append(temp)
 for num in nums:
 temp += num
 left\_sums.append(temp)
 index\_left = [0] \* length
 current\_max = 0
 for i in range(k - 1, length):
 if left\_sums[i + 1] - left\_sums[i + 1 - k] > current\_max:
 index\_left[i] = i + 1 - k
 current\_max = left\_sums[i + 1] - left\_sums[i + 1 - k]
 else:
 index\_left[i] = index\_left[i - 1]
 index\_right = [0] \* length
 current\_max = 0
 for i in range(length - k, -1, -1):
 if left\_sums[i + k] - left\_sums[i] >= current\_max:
 index\_right[i] = i
 current\_max = left\_sums[i + k] - left\_sums[i]
 else:
 index\_right[i] = index\_right[i + 1]
 the\_max = 0
 result = [0] \* 3
 for i in range(k, length - 2 \* k + 1):
 left = index\_left[i - 1]
 right = index\_right[i + k]
 current\_max = left\_sums[left + k] - left\_sums[left] + left\_sums[i + k] - left\_sums[i] + left\_sums[
 right + k] - left\_sums[right]
 if current\_max > the\_max:
 result = [left, i, right]
 the\_max = current\_max
 return result

### 2.143. 快速替换10亿条标题中的5万个敏感词

Aho-Corasick算法（AC自动机）：

* 构造一棵Trie树；
* 构造失败指针；
* 模式匹配。

参考：[AC自动机算法详解 - 极限定律 - C++博客](http://www.cppblog.com/mythit/archive/2009/04/21/80633.html)

### 2.144. 轮流取数的必胜策略

问题描述：有2N个自然数，甲乙两人轮流取。一人一次取一个，而且只能取头尾两个数中的一个，取过的数划去，直到2N个数取完，取得的数的总和大的人获胜。那么，先取的人是否有必胜策略？

解决方法：先取的人只要取了奇数位上的数，就把偶数位的数留给后取的人，而且只要坚持取奇数位上的数，就一直会把偶数位上的数留给后取的人。这样就会取走所有奇数位上的数。（这种方法同样可使先取的人把所有偶数位上的数取走）所以，先取的人只要一开始算出是所有偶数位上的数总和大，还是所有奇数位上的数总和大，就一定会胜。

### 2.145. 最大公约数（辗转相除法）

def gcd(a, b):
 while b:
 a, b = b, a % b
 return a

### 2.146. 最小公倍数

def lcm(a, b):
 return a \* b // gcd(a, b)