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| **Design an algorithm and write code to remove the duplicate characters in a string without using any additional buffer. Write the test cases for this method.** | **Implement a Doubly Linked List that has methods a) add b) remove.** |
| public string removeDuplicates(string str) {      //test cases : aaabbb, ababab, aaaa, abcd, null, "", aabc  if (string.IsNullOrEmpty(str) == true) return "";  var arr = str.ToArray();  int tail = 1;  for (int i = 1; i < arr.Length; i++) {  int j = 0;  for (; j < tail; j++) {  if (arr[i] == arr[j]) break;  }  if (j == tail) {  arr[j] = arr[i];  tail++;  }  }  var result = new char[tail];  for (int i = 0; i < result.Length; i++) {  result[i] = arr[i];  }  return new string(result);  } | public class DoublyLinkedList {  public Node head;  public Node tail;  public void add(int v) {  if (head == null) {  head = new Node(v);  tail = head;  return;  }  tail.next = new Node(v);  tail.next.prev = tail;  tail = tail.next;  }  public Node remove(int v) {  if (head == null) return null;  if (head.value == v) {  if (head == tail) {  var ret = head;  head = null;  tail = null;  return ret;  }  var ret2 = head;  head.next.prev = null;  head = head.next;  return ret2;  }  for (var node = head.next; node.next != null; node = node.next) {  if (node.value == v) {  node.prev.next = node.next;  node.next.prev = node.prev;  return node;  }  }  if (tail.value == v) {  var ret = tail;  tail.prev.next = null;  tail = tail.prev;  return ret;  }  return null;  }  } |
| **Write code to remove duplicates from an unsorted linked list without using a temporary buffer.** |
| public string removeDuplicates(DoublyLinkedList list) {  if (list == null || list.head == null) return;  var tail = list.head.next;  var prev = list.head;  for (var i = tail; i != null; i = i.next) {  Node j = list.head;  for (; j != tail; j = j.next) {  if (i.value == j.value) break;  }  if (j == tail) {  j.value = i.value;  prev = tail;  tail = tail.next;  }  }  prev.next = null;  } |

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| **Implement a) Stack b) Queue.** | | **Write code for Tower of Hanoi.** | | | | | | | | | | | | |
| public class Stack {  private Node top;  public void push(int v) {  var node = new Node(v);  node.next = top;  top = node;  }  public int pop() { {  if (top == null) return -1;  var ret = top.value;  top = top.next;  return ret;  }  }  public class Queue {  public Node head;  public Node tail;  public void enq(int v) {  if (head == null) {  head = new Node(v);  tail = head;  return;  }  var node = new Node(v);  tail.next = node;  tail = node;  }  public int deq() {  if (head == null) return -1;  var ret = head.value;  head = head.next;  tail = (head == null) ? null : tail;  return ret;  }  } | | public void hanoi(int n) {  if (n <= 0) return;  solve(n, 'A', 'B', 'C');  }  private void hanoi(int n, char from, char tmp, char to) {  if (n == 1) {  PrintLn("Moving " + n + " from " + from + " to " + to);  return;  }  solve(n - 1, from, to, tmp);  PrintLn("Moving " + n + " from " + from + " to " + to);  solve(n - 1, tmp, from, to);  } | | | | | | | | | | | | |
| **Implement the following algorithms: a) In-Order b) Pre-Order c) Post-Order d) Level-Order e) Insert Node Method** | | | | | | | | | | | | |
| public void PrintInOrder() {  PrintInOrder(Root);  } | | | | | | | public void PrintPreOrder() {  PrintPreOrder(Root);  } | | | | | public void PrintPostOrder() {  PrintPostOrder(Root);  } |
| private void PrintInOrder(Node node) {  if (node == null) return;  PrintInOrder(node.Left);  Print(node.ToString() + ", ");  PrintInOrder(node.Right);  }  private void PrintPreOrder(Node node) {  if (node == null) return;  Print(node.ToString() + ", ");  PrintPreOrder(node.Left);  PrintPreOrder(node.Right);  }  private void PrintPostOrder(Node node) {  if (node == null) return;  PrintPostOrder(node.Left);  PrintPostOrder(node.Right);  Print(node.ToString() + ", ");  } | | | | | | | | | | public void Insert(Node node) {  Root = Insert(Root, node);  }  private Node Insert(Node cur, Node node) {  if (cur == null) {  return node;  }  if (node.left < cur.left) {  cur.Left = Insert(cur.Left, node);  } else {  cur.Right = Insert(cur.Right, node);  }  return cur;  } | | |
| public void PrintLevelOrder() {  if (Root == null) return;  var q = new Queue<Node>(); q.Enqueue(Root);  while (q.Count > 0) {  var node = q.Dequeue();  Print(node.ToString() + ", ");  if (node.Left != null) q.Enqueue(node.Left);  if (node.Right != null) q.Enqueue(node.Right);  }  } | | | **Implement a) Depth First Search b) Breadth First Search** | | | | | | | | | public class AdjList {  private List<List<Edge>> vertexList;  public AdjList(int count) {  vertexList = new List<List<Edge>>();  for (int i = 0; i < count; i++) {  vertexList.Add(new List<Edge>());  }  }  } | | |
| public class Edge {  public int vertex { get; set; }  public int cost { get; set; }  public Edge(int v, int c) {  vertex = v;  cost = c;  }  } | | | | | | | | |
| public void DepthFirstSearch() {  if (vertexList == null || vertexList.Count() <= 0) return;  var hashSet = new HashSet<int>();  DepthFirstSearch(0, hashSet);  }  public void DepthFirstSearch(int vertex, HashSet<int> hashSet) {  hashSet.Add(vertex);  var edgeList = vertexList[vertex];  foreach (var edge in edgeList) {  if (hashSet.Contains(edge.vertex) == true) continue;  DepthFirstSearch(edge.vertex, hashSet);  }  } | | | | | | public void BreadthFirstSearch() {  var hs = new HashSet<int>();  var q = new Queue<int>();  q.Enqueue(0);  hs.Add(0);  while (q.Count > 0) {  var vertex = q.Dequeue();  var edges = map[vertex];  printf(vertex + " - ");  foreach (var edge in edges) {  if (hs.Contains(edge.vertex) == true) continue;  q.Enqueue(edge.vertex);  hs.Add(edge.vertex);  }  }  } | | | | | | | | |
| **Given a (decimal – e.g. 3.72) number that is passed in as a string, print the binary representation. If the number cannot be represented accurately in binary, print “ERROR”.** | | | | | | **Implement the following: a) Bubble Sort b) Selection Sort c) Merge Sort d) Quick Sort e) Bucket Sort** | | | | | | | | |
| private string PrintBinary(string n) {  var split = n.Split('.');  int num = Convert.ToInt32(split[0]);  var dec = Convert.ToDouble("0." + split[1]);  var decString = "";  var stack = new Stack<char>();  while (num > 0) {  stack.Push((num % 2 == 0) ? '0' : '1');  num >>= 1;  }  var sbNum = new StringBuilder();  var sbDec = new StringBuilder();  while (stack.Count > 0) sbNum.Append(stack.Pop());  while (true) {  if (sbDec.Length > 32) return "ERROR";  dec = dec \* 2;  if (dec > 1.0f) {  sbDec.Append('1');  dec -= 1.0f;  } else if (dec == 1.0f) {  sbDec.Append('1');  break;  } else {  sbDec.Append('0');  }  }  return sbNum.ToString();+ "." + sbDec.ToString();  } | | | | | | private void bubbleSort(int[] n) {  for (int i = n.Length - 1; i >= 0; i--) {  var swapped = false;  for (int j = 0; j < i; j++) {  if (n[j] > n[j + 1]) {  var tmp = n[j + 1];  n[j + 1] = n[j];  n[j] = tmp;  swapped = true;  }  }  if (swapped == false) break;  }  }  private void selectionSort(int[] n) {  for (int i = 0; i < n.Length; i++) {  int index = i;  for (int j = i + 1; j < n.Length; j++) {  if (n[j] < n[index]) {  index = j;  }  }  int tmp = n[i];  n[i] = n[index];  n[index] = tmp;  }  } | | | | | | | | |
| private int[] mergeSort(int[] n) {  return mergeSort(n, 0, n.Length);  }  private int[] mergeSort(int[] n, int s, int e) {  if (e - s <= 1) return new int[] { n[s] };  int mid = (s + e) / 2;  int count = e - s;  var left = mergeSort(n, s, mid);  var right = mergeSort(n, mid, e);  var tmp = new int[count];  int li = 0;  int ri = 0;  for (int index = 0; index < count; index++) {  if (li < left.Length && (ri >= right.Length || left[li] < right[ri])) {  tmp[index] = left[li++];  } else {  tmp[index] = right[ri++];  }  }  return tmp;  } | | | | | | | | | | public void quickSort(int[] n) {  quickSort(n, 0, n.Length - 1);  }  private void quickSort(int[] n, int s, int e) {  if (s >= e) return;  int p = partition(n, s, e);  quickSort(n, s, p - 1);  quickSort(n, p + 1, e);  }  private int partition(int[] n, int s, int e) {  int piv = n[e], p = e;  for (int i = 0; i < p; i++) {  if (n[i] > piv) {  swap(n, i, p - 1);  swap(n, p, p - 1);  i--;  p--;  }  }  return p;  } | | | | |
| public void bucketSort(int[] n) {  int max = Int32.MinValue;  for (int i = 0; i < n.Length; i++) max = (n[i] > max) ? n[i] : max;  var buckets = new List<int>[max + 1];  for (int i = 0; i < buckets.Length; i++) buckets[i] = new List<int>();  for (int i = 0; i < n.Length; i++) {  var b = n[i] % (max + 1);  buckets[b].Add(n[i]);  }  int index = 0;  for (int i = 0; i < buckets.Length; i++) {  var bucket = buckets[i];  for (int j = 0; j < bucket.Count; j++) {  n[index++] = bucket[j];  }  }  } | | | | | | | | | | **Implement binary search.** | | | | |
| public int BinarySearch (int[] arr, int key) {  int min = 0;  int max = arr.Length - 1;      while (min <= max) {          int mid = (min + max) / 2;          if (key == arr[mid]) {              return mid;          } else if (key < arr[mid]) {             max = mid - 1;          } else {              min = mid + 1;          }     }     return -1;  } | | | | |
| **Given an integer, write a function to determine if it is a power of three.** | | | | **Write a function to find a) gcd b) lcm of two numbers.** | | | | | | | | | | |
| public bool IsPowerOfThree(int n) {  return (Math.Log10(n) / Math.Log10(3)) % 1 == 0;  } | | | | public int gcd(int a, int b) {  while (b != 0) {  int t = b;  b = a % b;  a = t;  }  return a; } | | | | | | | | | //gcd(a,b) \* lcm(a,b) = ab  public int lcm(int a, int b) {  if (a == 0 || b == 0) return 0;  var t = gcd(a, b);  if (t == 0) return 0;  return (a \* b) / t;  } | |
| **Write an efficient algorithm that searches for a value in an *m x n* matrix. This matrix has the following property: it is sorted from left to right, top to bottom.** | | | | | **Implement a function to check if a tree is balanced. For the purposes of this question, a balanced tree is defined to be a tree such that no two leaf nodes differ in distance from the root by more than one.** | | | | | | | | | |
| public bool SearchMatrix(int[,] matrix, int target) {  if (matrix == null) return false;  var m = matrix.GetLength(1);  var n = matrix.GetLength(0);  if (m == 0 || n == 0) return false;  int start = 0, end = m \* n - 1;  while (start <= end) {  int mid = (start + end) >> 1;  int midX = mid / m;  int midY = mid % m;  if (matrix[midX, midY] == target) return true;  else if (target < matrix[midX, midY]) end = mid - 1;  else start = mid + 1;  }  return false;  } | | | | | public bool isBalanced() {  if (root == null) return false;  return getMaxDepth(root) - getMinDepth(root) <= 1;  }  public int getMinDepth(Node node) {  if (node == null) return 0;  return 1 + Math.Min(getMinDepth(node.left), getMinDepth(node.right));  }  public int getMaxDepth(Node node) {  if (node == null) return depth;  return 1 + Math.Max(getMaxDepth(node.left), getMaxDepth(node.right));  } | | | | | | | | | |
| **Implement a full tree with *n* nodes.** | **Given a sorted (increasing order) array, write an algorithm to create a binary tree with minimal height.** | | | | | | | | | | | | | |
| public Node createFullTree(int n) {  if (n <= 0) return null;  int cnt = 1;  var q = new Queue<int>();  var root = new Node(0);  q.Enqueue(root);  while (cnt < n && q.Count > 0) {  var node = q.Dequeue();  if (cnt++ < n) {  node.left = new Node(0);  q.Enqueue(node.left);  }  if (cnt++ < n) {  node.right = new Node(0);  q.Enqueue(node.right);  }  }  return root;  } | public Node createBinaryTree(int[] arr) {  if (arr == null || arr.Length == 0) return null;  return createBinaryTree(arr, 0, arr.Length - 1);  }  private Node createBinaryTree(int[] arr, int min, int max) {  if (min > max) return null;  int mid = (min + max) >> 1;  var node = new Node(arr[mid]);  node.left = createBinaryTree(arr, min, mid - 1);  node.right = createBinaryTree(arr, mid + 1, max);  return node;  } | | | | | | | | | | | | | |
| **Write an algorithm to find the ‘next’ node of a given node in a binary search tree where each node has a link to its parent for a) In-Order Successor b) Pre-Order Successor c) Post-Order Successor** | | | | | | | | | | | | | |
| public Node getInOrderSuccessor(Node node) {  if (node == null) return null;  if (node.parent == null || node.right != null) {  return getLeftMost(node.right);  }  var cur = node;  while (node.parent != null) {  node = node.parent;  if (node.left == cur) return node;  cur = node;  }  return null;  } | | | | | | | | | | private Node getLeftMost(Node node) {  if (node == null) return null;  while (node.left != null) node = node.left;  return node;  } | | | |
| public Node getPreOrderSuccessor(Node node) {  if (node == null) return null;  if (node.left != null) return node.left;  if (node.right != null) return node.right;  var cur = node;  while (node.parent != null) {  node = node.parent;  if (node.left == cur && node.right != null) {  return node.right;  }  cur = node;  }  return null;  } | | | | | | | public Node getPostOrderSuccessor(Node node) {  if (node == null) return null;  if (node.parent == null) return null;  if (node.parent.left == node) {  if (node.parent.right == null) return node.parent;  node = node.parent.right;  while (node.left != null) node = node.left;  while (node.right != null) node = node.right;  return node;  }  return node.parent;  } | | | | | | | |
| **Design an algorithm and write code to find the first common ancestor of two nodes in a binary tree. Avoid storing additional nodes in a data structure. NOTE: This is not necessarily a binary search tree.** | | | | | | | | **Given a string, find the first non-repeating character in it and return its index. If it doesn't exist, return -1.** | | | | | | |
| public Node getCommonAncestor(Node n1, Node n2) {  if (n1 == null || n2 == null || root == null) return null;  if (n1 == root || n2 == root) return null;  return getCommonAncestor(root, n1, n2);  }  private Node getCommonAncestor(Node parent, Node n1, Node n2) {  if (parent == null) return null;  if ((contains(parent.left, n1) && contains(parent.right, n2)) ||  (contains(parent.left, n2) && contains(parent.right, n1))) {  return parent;  }  else if (contains(parent.left, n1) && contains(parent.left, n2)) {  if (parent.left == n1 || parent.left == n2) return parent;  else return getCommonAncestor(parent.left, n1, n2);  }  else if (contains(parent.right, n1) && contains(parent.right, n2)) {  if (parent.right == n1 || parent.right == n2) return parent;  else return getCommonAncestor(parent.right, n1, n2);  }  return null;  }  private bool contains(Node node, Node target) {  if (node == null) return false;  if (node == target) return true;  return contains(node.left, target) || contains(node.right, target);  } | | | | | | | | public int FirstUniqChar(string s) {  var map = new int[26];  for (int i = 0; i < s.Length; i++) {  var c = s.ElementAt(i);  map[c - 'a']++;  }  for (int i = 0; i < s.Length; i++) {  if (map[s.ElementAt(i) - 'a'] == 1) return i;  }  return -1;  } | | | | | | |

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| **Given an integer *n*, return all distinct solutions to the *n*-queens puzzle. ‘Q’ and ‘.’ both indicate a queen and an empty space respectively.** |  |
| public List<List<string>> SolveNQueens(int n) {  if (n <= 0) return null;  var rows = new int[n];  for (int i = 0; i < n; i++) rows[i] = -1;  var result = new List<List<string>>();  var resultRows = new List<int[]>();  for (int j = 0; j < n; j++) {  rows[0] = j;  solveNQueens(rows, 1, resultRows);  }  foreach (var row in resultRows) {  var rowList = new List<string>();  for (int i = 0; i < n; i++) {  var sb = new StringBuilder();  for (int j = 0; j < n; j++) sb.Append((row[i] == j) ? "Q" : ".");  rowList.Add(sb.ToString());  }  result.Add(rowList);  }  return result;  }  private void solveNQueens(int[] rows, int i, List<int[]> list) {  if (i == rows.Length) {  list.Add(rows);  return;  }  for (int j = 0; j < rows.Length; j++) {  if (canPlace(rows, i, j) == true) {  var copy = new int[rows.Length];  Array.Copy(rows, copy, copy.Length);  copy[i] = j;  solveNQueens(copy, i + 1, list);  if (i + 1 == rows.Length) break;  }  }  }  private bool canPlace(int[] rows, int row, int col) {  for (int i = 0; i < rows.Length; i++) if (rows[i] == col) return false;  for (int i = 0; i < rows.Length; i++)  if (rows[i] != -1 && rows[i] - i == col - row) return false;  for (int i = 0; i < rows.Length; i++)  if (rows[i] != -1 && rows[i] + i == row + col) return false;  return true;  } |  |