Spring CS Finals Study Materials

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1 CS 121

1.1 General Concepts

- Basic data structures such as arrays, linked lists, stacks, queues, and trees.
- Basic algorithms such as searching, sorting, and traversal.
- Time and space complexity analysis of algorithms.
- Recursion and recursive algorithms.
- Basic graph algorithms such as breadth-first search and depth-first search
- Hashing and hash tables.

1.2 Problems

1.2.1 Basic data structures such as arrays, linked lists, stacks, queues, and trees.

A) True/False

1. An array is a dynamic data structure that can change size during runtime. (True/False)

2. In a singly linked list, each node contains a pointer to both the next and the previous node in the list. (True/False)

3. A stack is a data structure that follows the First-In-Last-Out (FILO) principle. (True/False)

4. A queue is a data structure that follows the Last-In-First-Out (LIFO) principle. (True/False)

5. In a binary search tree, the left subtree of a node contains only nodes with keys smaller than the node's key. (True/False)

B) Short Coding Problems

1. Write a function that takes an array of integers and returns the sum of all the even numbers in the array.

2. Implement a function that takes a singly linked list as input and returns the length of the list.

3. Write a function that takes a string as input and uses a stack to reverse the order of the characters in the string.

4. Implement a queue using two stacks. The queue should support the enqueue and dequeue operations.

5. Write a function that takes a binary search tree as input and returns the minimum value in the tree.

1.2.2 Basic algorithms such as searching, sorting, and traversal.

A) True/False Questions:

1. (T/F) Binary search can only be used on sorted arrays.

2. (T/F) QuickSort has a worst-case time complexity of O(n^2).

3. (T/F) Depth-first search is always guaranteed to find the shortest path between two nodes in a graph.

4. (T/F) Bubble sort is a stable sorting algorithm.

5. (T/F) Breadth-first search can be used to check if a graph is bipartite.

Short Coding Problems:

1. Implement a function that takes in an array of integers and returns the same array sorted in ascending order using the selection sort algorithm.

2. Implement a function that takes in a binary search tree and returns the sum of all the values in the tree.

3. Implement a function that takes in a graph represented as an adjacency list and performs a breadth-first search starting from a given node. The function should return the order in which the nodes were visited.

4. Implement a function that takes in two sorted arrays and returns their intersection as a new sorted array.

5. Implement a function that takes in an array of integers and returns the maximum and minimum values in the array using divide and conquer algorithm.

1.2.3 Time and space complexity analysis of algorithms.

A) True/False Questions:

1. T/F: The time complexity of the bubble sort algorithm is O(n^2).

2. T/F: A binary search can only be performed on a sorted array.

3. T/F: The time complexity of the selection sort algorithm is O(n log n).

4. T/F: A binary search tree can have multiple nodes with the same value.

5. T/F: Breadth-first search is guaranteed to find the shortest path in a weighted graph.

B) Short Coding Problems:

1. Write a function to check if a given string is a palindrome.

2. Implement a stack using an array.

3. Given two arrays, write a function to find their intersection.

4. Implement a binary search algorithm to find a target value in a sorted array.

5. Write a function to sort an array of integers using the selection sort algorithm.

1.2.4 Recursion and recursive algorithms.

A) True/False Questions:

1. Recursion is a technique where a function calls itself.

2. Recursive algorithms are always more efficient than iterative algorithms.

3. The base case in a recursive function is the case where the function stops calling itself.

4. A recursive function that doesn't have a base case will result in an infinite loop.

5. Tail recursion is a type of recursion where the recursive call is the last statement in the function.

B) Short Coding Problems:

1. Write a recursive function to find the factorial of a positive integer.

2. Write a recursive function to compute the nth number in the Fibonacci sequence.

3. Write a recursive function to reverse a string.

4. Write a recursive function to find the greatest common divisor of two integers.

1.2.5 Hashing and hash tables.

A) True/False Questions:

1. A hash function maps a large data set to a smaller data set by assigning a unique key to each item in the data set. (True/False)

2. Collision resolution is the process of handling situations when two or more items in a hash table map to the same index. (True/False)

3. Open addressing is a collision resolution technique where collisions are resolved by storing the colliding items in a linked list at the same index. (True/False)

4. A perfect hash function is a hash function that maps each item in a data set to a unique index in a hash table without any collisions. (True/False)

5. The worst-case time complexity of searching for an item in a hash table using chaining is O(n), where n is the number of items in the hash table. (True/False)