Faculty of Engineering and Applied Science

SOFE 3950U Operating Systems

Tutorial Report 8, CRN 74171

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Conceptual Questions

1. **What is an Abstract Data Type (ADT)?**

An Abstract Data Type (ADT) is a theoretical concept in computer science that describes a data type based on its behavior and operations, rather than on its implementation details. It defines a set of operations that can be performed on a data type, without specifying how those operations are implemented.

2. **Explain the difference between a queue (FIFO) and a stack (LIFO).**

A queue follows the First-In, First-Out (FIFO) principle, meaning that the first element added to the queue will be the first one to be removed. A stack, on the other hand, follows the Last-In, First-Out (LIFO) principle, meaning that the last element added to the stack will be the first one to be removed.

3. **Name and briefly explain three types of data structures.**

Name of data structure	**Description**
Array	An array is a collection of elements of the same data type that are stored in contiguous memory locations. Elements in an array can be accessed using an index, which represents the position of the element in the array.
Linked list	A linked list is a data structure consisting of a sequence of nodes, where each node contains a value and a reference to the next node in the sequence. Linked lists can be used to implement dynamic data structures, where the size of the list can change during runtime.
Tree	A tree is a data structure consisting of a set of nodes that are connected by edges. Each node in a tree can have zero or more child nodes. Trees are often used to represent hierarchical structures, such as file systems, organization charts, or the structure of a website.

4. **Explain what a binary tree is, what are some common operations of a binary tree?**

A binary tree is a tree data structure in which each node can have at most two child nodes, known as the left child and the right child. The child nodes themselves are also binary trees. In a binary tree, the topmost node is called the root node, and each node can have up to two child nodes, which are called the left child and the right child. Nodes with no children are called leaf nodes. A binary tree can be empty, which means it contains no nodes.

Some common operations that can be performed on a binary tree include:

Insertion: Adding a new node to the tree.
Deletion: Removing a node from the tree.
Traversal: Visiting all nodes in the tree in a specific order, such as depth-first or breadth-first.
Searching: Finding a node in the tree that matches a given key or value.

5. **Explain what a hash table (dictionary) is, what are common operations of a hash table?**

A hash table, also known as a dictionary or map, is an abstract data type that stores data in key-value pairs. It uses a hash function to compute an index into an array of buckets or slots, where the corresponding value is stored. The hash function takes the key as input and returns an index that corresponds to the slot in the array where the value is stored.

Some common operations that can be performed on a hash table include:

Insertion: Adding a new key-value pair to the hash table.
Deletion: Removing a key-value pair from the hash table.
Lookup: Finding the value associated with a given key.
Update: Changing the value associated with a given key.

Application Questions

See attached code.