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1.

(a) Recursion is a programming technique in which a method can call itself to fulfill its purpose.

(b) All recursive definitions must have a non-recursive part in order to terminate the recursive path. A definition without a non-recursive part causes infinite recursion.

(c) Base case is needed to prevent the definition from infinite looping (infinite recursion).

(d) No. Recursion is not necessary.

(e) Recursion has the overhead of multiple method invocations. But for some problems, recursive solutions are often more simple and elegant to express. However, a recursive solution may be less efficient compared to an iterative solution.

2.

(a) The expected case for finding an element with a linear search is n/2, which is O(n); the worst case is also O(n) and the best case is O(1).

(b) The best case for finding an element with a binary search is O(1), the expected case is O(log(n)), and the worst case performance is O(log(n)).

(c) Linear search would be preferred over a binary search when the list is unsorted.

(d) Binary search requires the list to be sorted.

(e) When would a sequential sort be preferable to a recursive one?

(f) Selection sort orders a list of values by repetitively putting a particular value into its final position.

(g) The Bubble Sort orders a list of values by repetitively comparing neighboring elements and swapping their positions if necessary.

(h) The best case for sorting with Bubble sort is O(n), expected case is O(n^2) and the worst case is O(n^2).

(i) Quick sort orders values by partitioning the list around one element, then sorting each partition.

(j) The best case for sorting with quick sort is O(nlog(n)), expected case is O(nlog(n)), and the worst case is O(n^2).

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3.

(a) A tree is a non-linear structure in which elements are organized into a hierarchy. A tree is compromised of a set of nodes in which elements are stored and edges connect one node to another. Each node is located on a particular level. There is only one root node in the tree.

(b) The root is the only node which has no parent. We can follow a path through a tree from parent to child, starting at the root. A node is an ancestor of a node if it is above it on the path from the root.

(c) A node that has no children is a leaf node.

(d) The height of a tree is the length of the longest path from the root to a leaf.

(e) Given a tree of height N, it would take O(log(n)).

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